THE REFINER AND NATURAL GASOLINE MANUFACTURER

AUGUST, 1926

NEWS INDEX - - - 19
ADVERTISERS INDEX - 90

VOLUME 5 NUMBER 8

THE JOHN CRERAR LIBRARY. AUG 19 1926

Vacuum!

for special processes

Group of Elliott-Ehrhart Air Ejectors, showing wide range of size and type.

THE modern vacuum pump is a steam jet air ejector. In its various types—single-stage, multi-stage, and combination units—the ejector has all the requirements of the ideal vacuum pump, and none of the disadvantages of the older form.

Elliott-Ehrhart Ejectors can be supplied for any vacuum require ment. In many cases they have made possible the utilization of vacua formerly impossible. They may be designed for any operating steam pressure or for various pressures if need be. They establish vacuum very quickly. They are amazingly simple and compact, requiring no attention, lubrication, supervision or up keep. They are extremely flexible.

ELLIOTT EHRHART AIR EJECTORS

LET us discuss with you the application of these modern vacuum producers to your particular requirements.

JEANNETTE, PA.
DISTRICT OFFICES
ATLANTA, BALTIMORE, BOSTON, CHICAGO, CINCINNATI, DETROIT, CLEVELAND, NEW YORK, KANSAS CITY, ST. LOUIS, PHILADELPHIA AND PITTSBURGH

ELLIOTT COMPANY

PRODUCTS
STEAM TURBINES, REDUCTION GEARS, DEAERATORS, HEATERS, CONDENSERS, AIR EJECTORS, AUTOMATIC NON-RETURN VALVES, BLOW-OFF VALVES, GREASE EXTRACTORS, STRAINERS, SEPARATORS

BRAUN

ATMOSPHERIC COOLING TOWERS

Repeat Orders Indicate Satisfactory Service

...Repeat orders on Braun Cooling Towers are the best indication of the satisfactory service. The small photo on the left shows the first unit of one Braun installation that was later increased to three units by the addition of the two towers in the larger photograph.

C. F. BRAUN & CO.
Manufacturing Mechanical Engineers
Tulsa Alhambra, Calif. Dallas

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the Act of March 3, 1879.

LUMMUS

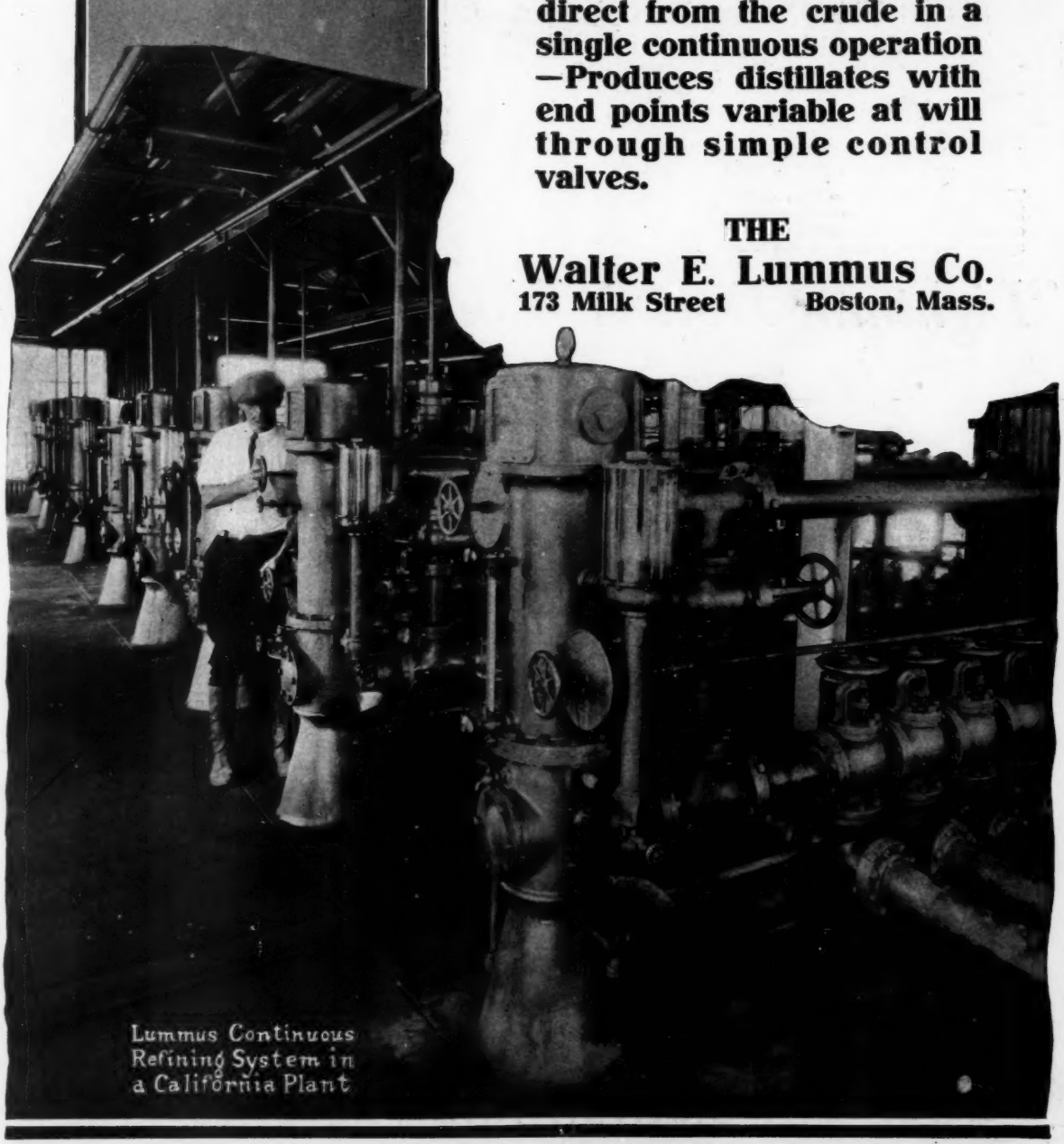
Low Temperature Refining System

Separates all of the gasoline direct from the crude in a single continuous operation —Produces distillates with end points variable at will through simple control valves.

THE

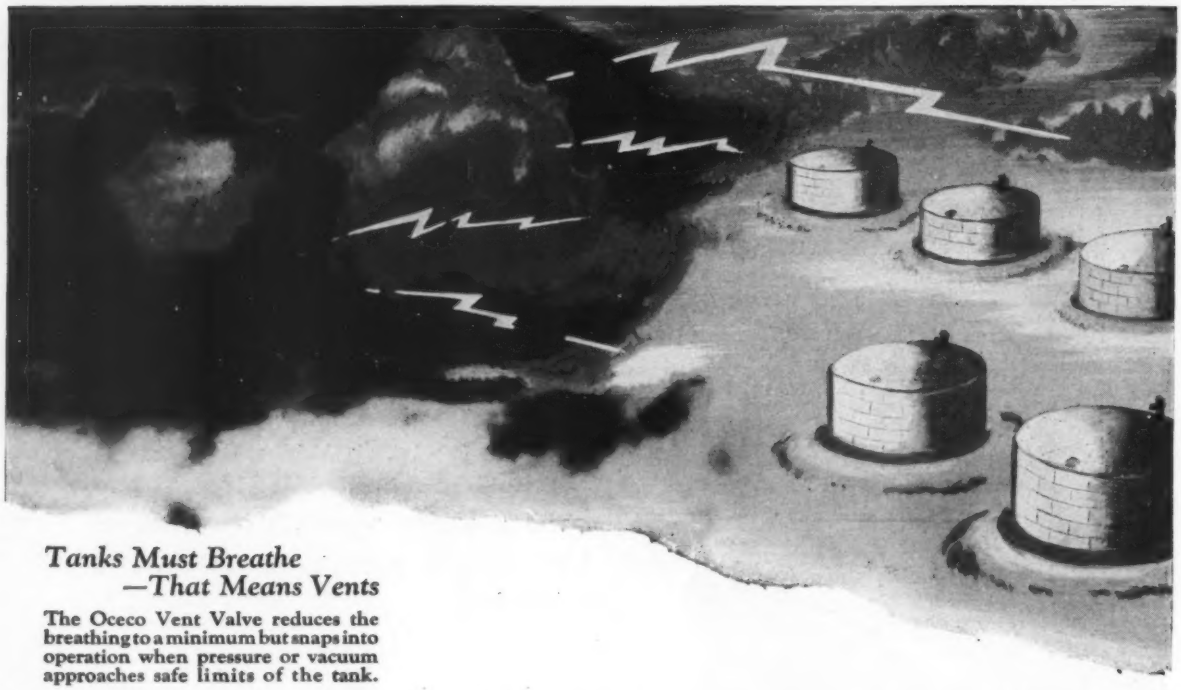
Walter E. Lummus Co.

173 Milk Street Boston, Mass.



Lummus Continuous Refining System in a California Plant

Mention Where You Saw the Advertisement



Tanks Must Breathe
—That Means Vents

The Oceco Vent Valve reduces the breathing to a minimum but snaps into operation when pressure or vacuum approaches safe limits of the tank.

"Lightning Doesn't Worry Us Any More"

Says the Manager of a Large Eastern Refinery where Millions of Barrels of Oil are in Storage

"SEE those tanks over there", he said, with a fling of his arm, "lightning has danced and flashed all about them—fire has been all around them—grass is burnt right up to the tanks!"

"Worry? No more! Those tanks are Oceco equipped. We're not afraid of lightning or fire!"

The tanks referred to are equipped with Oceco Flame Arrestors. Even though vapors above and around are ignited, no fire can get through. Fire has *never* gone through an Oceco Flame Arrestor.

Let us figure on your requirements for sure *protection against fire—and worry.*

THE OIL CONSERVATION ENGINEERING COMPANY
877 Addison Road *Headquarters for Tank Equipment* Cleveland, Ohio

ENGINEERING AND SALES SERVICE AT:—

25 Broadway . . . . . New York
325 Iowa Building . . . . . Tulsa, Okla.
O-S Building . . . . . Casper, Wyo.
W. K. Henderson Co. . . . . Shreveport, La.
Neilan, Schumacher & Co. . . . Los Angeles, Cal.
Arthur Dooley, Box 552 . . . . Beaumont, Texas

OIL TANK **OCECO** EQUIPMENT
SAVES EVAPORATION AND PREVENTS FIRE

The Holmes-Manley *Cracking* Process

A distinctive feature of this process is its higher yield of finished stable gasoline. Rerunning and its consequent losses are obviated, and treating losses are reduced to a minimum

The Licensee receives:—

1. *A Proven Process*
2. *Complete Technical Service*
3. *The Benefit of Future Developments*

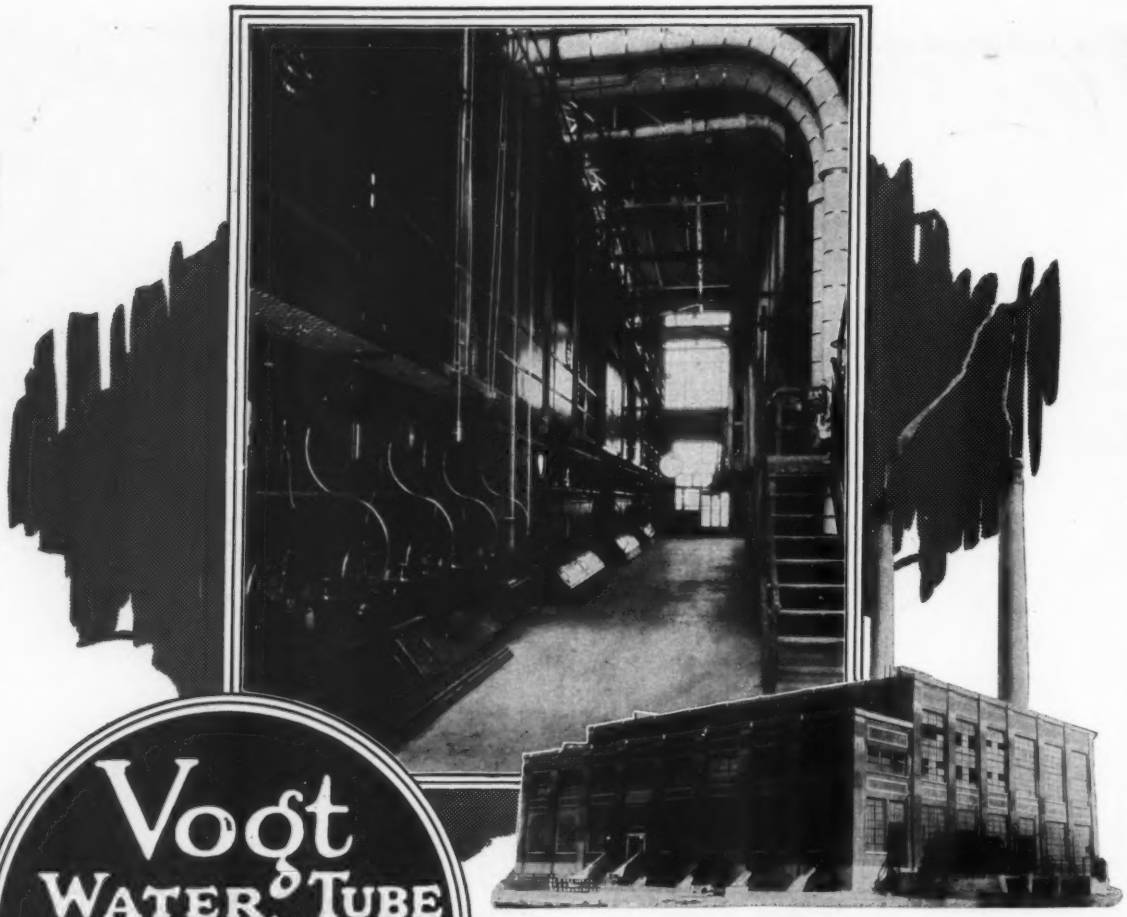
Licenses Granted by

THE TEXAS COMPANY, U. S. A.

Apply to

W. S. S. RODGERS

17 Battery Place, New York, N. Y.



Vogt WATER TUBE BOILERS *Equipped With Oil Burners*

A beautiful building does not always indicate an economical power plant, but it is generally found that those who take pride in the appearance of their power plant are equally cautious when selecting the most efficient steam producers. The illustration shows a modern power plant of one of the larger oil refineries operating 13,000 Horse Power of Vogt Straight Tube Water Tube Boilers.

HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE, KY.

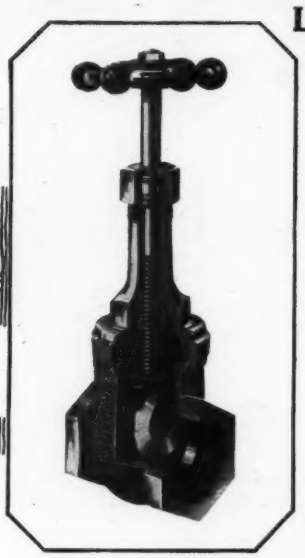
New York Chicago Philadelphia Cleveland Dallas

Manufacturers of: OIL REFINERY EQUIPMENT, DROP FORGED STEEL VALVES AND FITTINGS, WATER TUBE AND HORIZONTAL RETURN TUBULAR BOILERS, ICE MAKING AND REFRIGERATING MACHINERY.

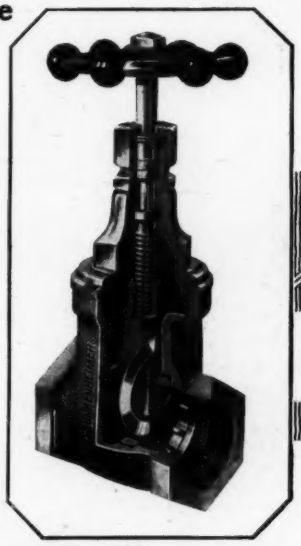
The Ultimate Test of Valve Value

Long SATISFACTORY Service with Minimum Maintenance Expense

Nothing better identifies a high quality valve than its ability to render a definite service for the longest period of time in the most efficient manner.



Bronze Double Disc Gate Valve



Bronze Wedge Disc Gate Valve

LUNKENHEIMER
BRONZE
GATE VALVES

are everywhere recognized as long life valves, embodying all the requisites essential for economical and efficient service. Once installed they require very little attention; they remain tight under severe conditions, and maintenance expense is negligible.

The complete line offers a type and size to meet any requirement, facilitating standardizing on "Lunkenheimer" wherever Bronze Gate Valves are used. The economies resulting from such standardization will prove a source of satisfaction to every valve user.

Lunkenheimer Distributors, located in all industrial centers, carry complete stocks and render prompt service. Call on them for your requirements.

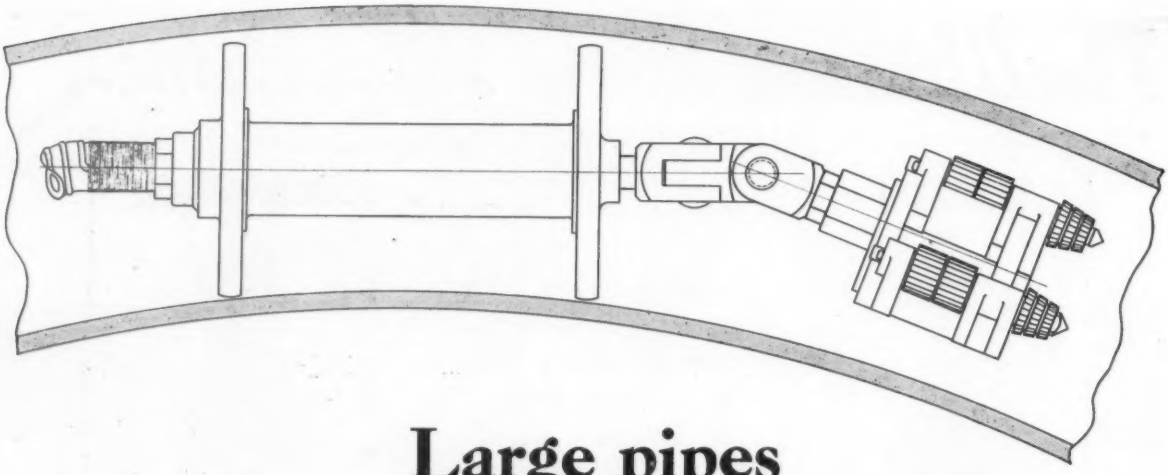
Detailed information is contained in Folder F 550. HJ
Fill in and mail the coupon for your copy. No obligation.

THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO BOSTON LONDON
EXPORT DEPT. 129-135 LAFAYETTE ST., NEW YORK

THE LUNKENHEIMER CO. "QUALITY"
Gentlemen—Please send me, without obligation, a copy of your Bronze Gate Valve Folder 550. HJ.
P. O. Box 876, Cincinnati, Ohio
Name
Firm
Position
Address

11012-18-89

Mention Where You Saw the Advertisement



Large pipes as well as small tubes may be Liberty cleaned

A complete tube cleaning service for oil refineries is furnished by the various sizes and types of Liberty Cleaners.

The illustration above is reproduced from a tracing of a TANDEMTYPE Liberty Cleaner, designed for cleaning the 8″ O. D. vapor lines of a Dubbs still. It is simply representative of the work we are doing in fitting our cleaners to all sorts of tube cleaning requirements in the oil refinery.

In addition to the cleaning of the pressure still tubes themselves, we are constantly designing and furnishing cleaners for all of the different tubes and pipes of various size and curvature encountered in the different processes. Our experience with such work is of benefit to you, and we can furnish exactly the proper type of cleaner and cutting head for the particular work contemplated.

Let us work with you.

Periodical cleaning of boilers, pressure stills and all tubes and pipes through which a heat transfer is accomplished, is a necessary procedure if efficiency is to be maintained. There is a Liberty Cleaner exactly suited to all such service.

Liberty Manufacturing Co.

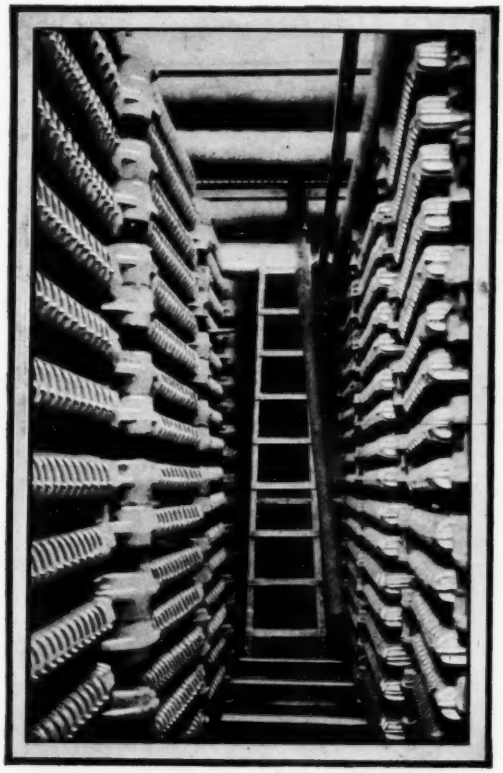
443 Grant Street, Pittsburgh, Pa.

Z-1040

Mention Where You Saw the Advertisement

The leaders in the industry point the way

Two more of the world's largest refineries of over 70,000 barrels capacity a day have just completed installation of Sterling Oil Sections and Accessories



Condenser Box in Plant of Champlin Refining Co., Enid, Oklahoma

When the world's largest refineries adopt any product, it means that they have done so only after the most careful tests.

The two large refineries that have been added to the list of Sterling Oil Sections users have added this equipment for two different reasons.

In one instance, Sterling Oil Sections were installed to reduce maintenance cost through accessibility for cleaning. In the other case they were installed because of their space saving and efficiency.

Sterling Oil Sections have replaced old-styled surface in scores of refineries and absorption plants. Their many points of superiority are described in an attractive new book which we shall be glad to send you.

Perhaps we can point out savings to you similar to those above. The services of our engineers are available on request.

STERLING OIL SECTIONS

For manifold use-for continuous use-for cooling

AMERICAN RADIATOR COMPANY

Manufacturers of IDEAL BOILERS *for* OIL BURNING

40 West 40th Street, New York, N.Y. 816 South Michigan Avenue, Chicago, Ill.

ALSO SOLD BY NATIONAL SUPPLY COMPANIES

Sterling Oil Sections are immediately available at our plants in Kansas City, Mo., and Springfield, Ohio

JENKINS CRACKING PROCESS

PRODUCES QUALITY GASOLINE

Facts from performance

CORROSION

One of the features of the Jenkins Cracking Process is that no appreciable corrosion occurs at any point of the equipment irrespective of the charging stock.

This gives a much longer life to the entire unit with no excessive depreciation or maintenance costs.

GRAVER *Founded 1857 Corporation*

EAST CHICAGO, INDIANA

NEW YORK Grand Cent. Term. | CHICAGO Steger Building | TULSA Atlas Life Bldg. | HOUSTON West Building

first in Accuracy

METRIC orifice METERS

For Gas

For Steam

That Metric Meters doing Gas and Oil measuring service are so well known for their accuracy is because back at the factory in Erie, Pennsylvania, accuracy is considered to be the primary attainment in each meter made. In every operation and with every worker in the plant, this result is the chief consideration. Were it not so the Metric Orifice Meter would not be, as it now is, the standard of accuracy.

Back of such accuracy must be good materials and exceptional workmanship. And back of it all, for the best results in dependable, economical measuring, must be the willingness for service that follows each meter into every job and stays with it—available at all times.

Each Metric Orifice Meter has behind it 38 years of rich meter making experience and the success of the largest meter manufacturer in America.

Write for the new Orifice Meter Bulletin No. 123

WESTCOTT & GREIS, INC.

Sales Service

Dallas TULSA Los Angeles

For Oil

For Water

METRIC METAL WORKS

of the American Meter Company-Inc.

ERIE - PENNSYLVANIA - U-S-A

STOP PIPE CORROSION
IN SMALL LINES

Our Simplex Prepared Joint Cast Iron Pipe is made in 2″, 3″, 4″ or 6″ diameters. Since it has been available thousands and thousands of feet of this material has been used in the oil fields.

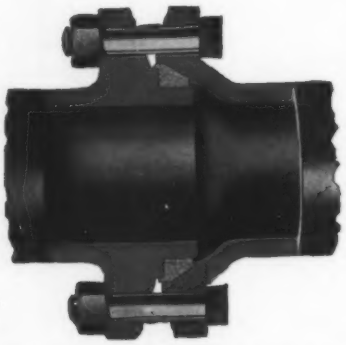


Illustration of section through assembled joint of Simplex Prepared Joint Five-Foot pipe, showing asbestos endless ring gasket in place. This gasket is adapted to use for oil, vapor and acid lines. A rubber gasket is compounded to suit the particular service it is to render—steam, natural gas, artificial gas, water, oil, etc.

Its chief advantage lies in its immunity from corrosion as compared with other ferrous pipe. Its desirability is further increased by the special joint, with only two bolts, and with a thick, endless ring gasket. It is rapidly and easily laid by inexperienced men.

Wherever permanent construction is desired, it is little short of an economic crime to spend money for a pipe line of perishable material when a practically permanent construction can be obtained by the use of cast iron.

Do you know why cast iron withstands corrosion so much better than any other ferrous metal? Our Bulletin No. 44 explains it.

Simplex Prepared Joint Pipe is furnished with full line of fittings. The material is fully described and illustrated in our Catalog No. 48. Your copy is waiting to be mailed, upon receipt of your request.

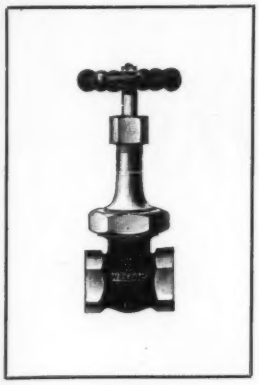
American Cast Iron Pipe Company

General Offices and Foundry: Birmingham, Ala.

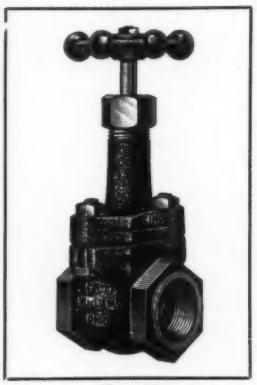
Branches at
Dallas, Kansas City, San Francisco, Los Angeles, Chicago, New York, Minneapolis

Write Also for Information on Our Simplex Cast Iron Pipe for Oil Condensers

Protect the Vital Points



No. 127
Bronze Gate Valve
For 200 lbs. pressure.
Sizes ¼" to 3"



No. 300
"Cino" Iron Gate Valve
For 125 lbs. pressure.
Sizes ¼" to 3"

No. 131
Bronze Quick Opening Gate Valve
For 200 lbs. pressure.
Sizes ¼" to 4"

At hundreds of points valves are the direct guardians of the bank account, standing between the waste of heat, cold and pressures that means precious fuel lost and the leakage of acids, gases or other materials. Among the smallest of equipment in the power and manufacturing plant and refineries, valves may shut down great boilers, stop machines or processes, hold up production and ruin products—if they fail.

Poor valves are expensive at any price, and good valves are cheap at the highest price.

Williams Valves are the loyal, capable guardians that never fail, never disappoint and are faithful to the service for which each is built.

At thousands of vital points in every kind of industrial plant—on land and sea—Williams Valves are guarding the power, processes and profits of industry.

The name "Williams" on a valve is at once a safeguard against accident, a surety of service and the sign of lowest cost per year of use.

"Williams" is the general guarantee of specific valve service for each valve type we make, one of which fully meets each need in most advanced engineering practice.

If you want maximum valve service at minimum expense—specify "WILLIAMS" on your next order. Your dealer can supply you.

The D. T. Williams Valve Co.

Cincinnati, Ohio.

Makers of High Grade Bronze and Iron, Regrinding and Nickel Seat Stop and Check Valves, Gate, Blowoff, Hydraulic, Swing and Ball Check, Needle, Hose, Whistle Valves, Stop and Air Cocks, Unions, Fittings, Water Gauges, Gauge Cocks, Oil Gauges, Lubricators, Oil and Grease Cups, Steam Traps, Separators.

No. 780
"Reverso" Bronze Globe Valve
Reversible Nickel Disc and Seat. For 200 lbs. pressure.
Sizes ¼" to 3"

No. 460
"Iroverso" Iron Globe Valve.
Bronze Mounted Reversible Nickel Disc and Seat.
For 150 lbs. pressure.
Sizes ¼" to 2"

No. 107
Bronze Regrinding Valve
For 200 lbs. pressure
Sizes ¼" to 3"

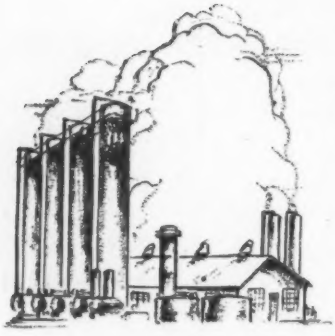
Williams Valves

SUNOCO

Absorption Oils 630 and 670

manufactured especially for Natural Gasoline Plants

The initial of the 670 Oil insures easier fractionation and is especially beneficial in plants which are overloaded. This oil has a short boiling range of 160 degrees, which is the reslut of a low molecular weight, indicating thereby a better capacity for gasoline and especially the higher boiling point constituents in natural gasoline. The 670 Oil is particularly adapted to straight steam stills, whereas the 630 grade is refined for fire or combination distillation where a lower initial oil would be more advantageous, maximum stripping of the oil being accomplished with less heat.



Samples and Quotations furnished upon request.

SUN COMPANY

Petroleum Bldg., Tulsa, Oklahoma

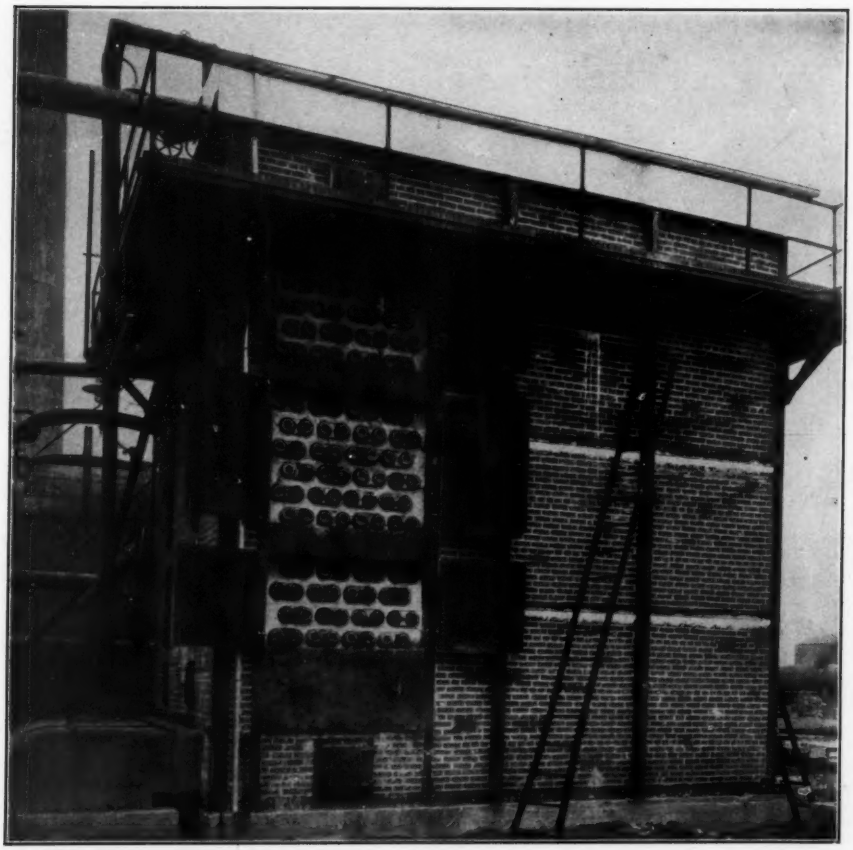
Refineries at

Marcus Hook, Pa. Yale, Okla. Toledo, Ohio

Mention Where You Saw the Advertisement

FOSTER

TUBE STILLS



The result of over 20 years of experience in solving problems requiring use of heat.

Foster Tube Still design prevents overheating by rapid and positive circulation, assures uniform heating by arranging all tubes to supply heat with practically equal effectiveness, secures minimum fuel consumption by gradual, continuous, thorough heating effect with complete combustion.

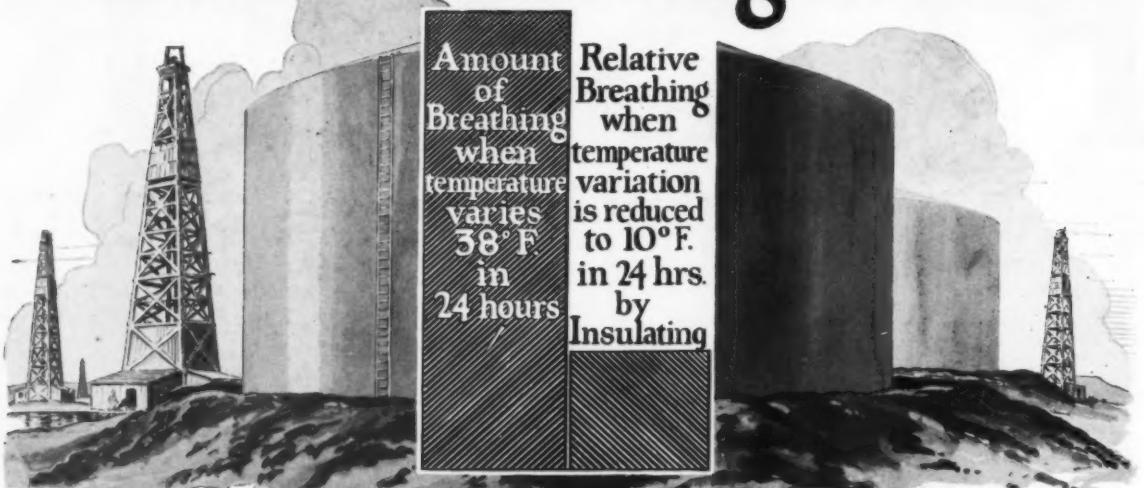
POWER SPECIALTY COMPANY

111 Broadway, New York

Branch Offices in All Oil Centers

Mention Where You Saw the Advertisement

Reduce Breathing Losses


Amount of Breathing when temperature varies 38° F. in 24 hours
Relative Breathing when temperature variation is reduced to 10° F. in 24 hrs. by Insulating

by reducing the temperature variation inside the tank -

SIL-O-CEL
HEAT INSULATION

The simple way to reduce "breathing losses" from gasoline storage tanks is to reduce breathing.

Breathing can be effectively reduced by insulating the tanks against rapid temperature changes.

One and one-half to one and three-quarter inches of Sil-O-Cel insulation is ample for this purpose.

The construction illustrated at the right reduces the fire hazard as well as the breathing losses. It protects the tank from weathering. It does not interfere in any way with charging or discharging the tank.

In gasoline savings alone its entire cost is ordinarily returned within sixty days. Write for our Engineering Bulletin R-19 which describes the most economical method of insulating storage tanks of every type.

GASOLINE STORAGE TANK
Insulation Details -
Steel Shell -
Sil-O-Cel Sticking Cement -
1¼" Sil-O-Cel Split Insulating Brick -
Wire Re-inforcing -
½" Sil-O-Cel Hard finish Cement -
Celcote Waterproofing or Painted Canvas -

CELITE PRODUCTS COMPANY

NEW YORK · · 11 BROADWAY
CHICAGO · 53 W. JACKSON BLVD.
LOS ANGELES · 1320 SO. HOPE ST.
SAN FRANCISCO · 140 SPEAR ST.

OFFICES AND WAREHOUSES IN PRINCIPAL CITIES

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MONTREAL · · · QUEBEC

CELITE · PRODUCTS · CORPORATION
147 WINDSOR HOUSE WESTMINSTER
LONDON · · · ENGLAND

Mention Where You Saw the Advertisement

ADAMANT
FIRE BRICK CEMENT
Reg. U. S. Pat. Off.

is carried in stock in 100lb., 250lb. and 400lb. air tight, metal containers by these distributors:

(Distributors listed under name of city. Write distributor in nearest city.)

Aspinwall, Pa.
The Gas Combustion Company
Baltimore, Md.
King's Coal and Supply Company, Inc.
Beaumont, Texas
Norvell-Wilder Hardware Company
Birmingham, Ala.
Young and Vann Supply Co.
Boston, Mass.
Waldo Bros. and Bond Company
Buffalo, N. Y.
Globe Plaster Company
Chicago, Ill.
Wm. E. Dee Company
Cincinnati, Ohio
The Wm. T. Johnston Co.
Cleveland, Ohio
H. W. Jarrett
Corpus Christi, Texas
San Antonio Machine & Supply Co.
Dallas, Texas
The Murray Company
Denver, Colo.
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El Paso, Texas
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Erie, Pa.
G. C. Thayer and Son
Houston, Texas
Norvell-Wilder Hardware Company
Indianapolis, Ind.
Indianapolis Belting & Supply Co
Kansas City, Mo.
Union Material & Supply Co.
Los Angeles, Cal.
Industrial Supply Co.
Louisville, Ky.
E. D. Morton & Company, Inc.
Memphis, Tenn.
Reed and Duecker
Milwaukee, Wis.
Tews Lime & Cement Co.
Minneapolis, Minn.
Northern Machinery Company
Mohawk, N. Y.
The American Hard Wall Plaster Co.
New Britain, Conn.
Rackliffe Bros. Co., Inc.
New Haven, Conn.
The Warner-Miller Co.
New Orleans, La.
Woodward Wight & Company, Ltd.
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C. C. Phillips, 110 W. 34th St.
Omaha, Neb.
American Machinery & Supply Co.
Pittsburgh, Pa.
The Gas Combustion Company
Post Office Box No. 1753
Portland, Ore.
The M. L. Kline Co.
Providence, R. I.
B. & H. Supply Company, Inc.
Reading, Pa.
Reading Foundry and Supply Co.
Rochester, N. Y.
American Clay & Cement Corp.
Wm. Summerhays & Son
Rome, N. Y.
The American Hard Wall Plaster Co.
St. Albans, West Va.
Edw. C. Kirk & Sons
St. Louis, Mo.
Reed Railway Supply Co.
San Antonio, Texas
San Antonio Machine & Supply Co.
San Francisco, Cal.
W. E. Mushet Co.
Seattle, Wash.
Cragin & Co.
Spokane, Wash.
Consolidated Supply Company
Springfield, Mass.
Oscar F. Carlson
Superior, Wis.
The Speakes Company
Syracuse, N. Y.
The Paragon Plaster Co.
Toledo, Ohio
The Toledo Builders Supply Co.
Tulsa, Okla.
Standard Asbestos & Cork Company
Utica, N. Y.
The American Hard Wall Plaster Co.
Waco, Texas
San Antonio Machine & Supply Co.
Worcester, Mass.
Waldo Bros. and Bond Company

Canadian Distributors

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Montreal, Quebec
Alex. Bremner, Ltd.
Port Arthur, Ontario
Wells & Emmerson
Toronto, Ontario
J. H. Morrison
Vancouver, B. C.
B. C. Equipment Company, Ltd.
Winnipeg, Manitoba
[illegible] Bairas & Company Ltd.

How A Mid-Continent Refinery *Tripled* Brickwork Service

AT one of the mid-continent refineries of a certain refining company*, fire brick construction in boilers and cracking stills was formerly laid up with fire clay or weak-bonding cements.

As fire clay and most fire cements lack bonding strength, joints made with them were weak. Under the attack of flame and heat, or when subjected to temperature changes and flame's cutting action, joints soon opened up. Brick spalled, cracked and dropped out. Walls bulged, crept and traveled. Soon the still or boiler furnace needed re-lining. Naturally, brickwork maintenance costs were high.

The Refinery Superintendent decided to try ADAMANT, (the ORIGINAL high temperature cement) in a re-lining job on ten stills and four boilers. Brick were dipped in ADAMANT, which made thin, strong joints, that held their bonds through all temperatures. Fire-exposed surfaces were painted with a thin wash of ADAMANT, brushed on like paint onto wood, and worked well into the pores and joints. Cracking and spalling of brick, as well as bulging, creeping and traveling of walls, were eliminated. The settings laid up with ADAMANT lasted three times longer!

If you would welcome longer brick life—if you are interested in reducing your refractories maintenance costs, use ADAMANT when you next repair your fire brick construction. Fill in and mail the coupon. No obligation, of course.

*Name on request.

ADAMANT
FIRE BRICK CEMENT

The pioneer high temperature cement with a twenty-five year record of successful application—a fire brick cement that has been thoroughly proven in a number of refineries.

BOTFIELD REFRACTORIES CO.
783 S. Swanson St., Philadelphia, Pa.
New York Office: 5th Floor, 110 W. 34th St.

Send The Coupon!

Botfield Refractories Co.,
783 South Swanson Street,
Philadelphia, Pennsylvania.

We are interested in prolonging fire brick construction life, and in reducing refractories costs.

Name and Title .....

Company Name .....

Street Address .....

City and State .....

Mention Where You Saw the Advertisement

COOPER

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SIX MONTHS AGO we were faced with a suggestion to lower prices still further. A steadily increasing sales volume, greater purchasing power and still better production tools and methods would have made an additional reduction possible. A careful study of the situation revealed that engine buyers had always recognized a higher quality in COOPER ENGINES, and in a majority of cases had been willing to pay extra for a better engine. We were convinced that what the trade wants is still better gas engines at reasonable prices—not necessarily cheaper engines.

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ENGINES

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AUGUST, 1926

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GRADY TRIPLETT, *Editor*

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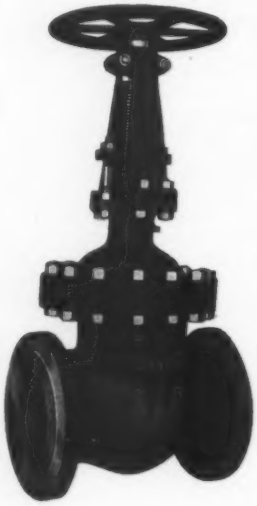

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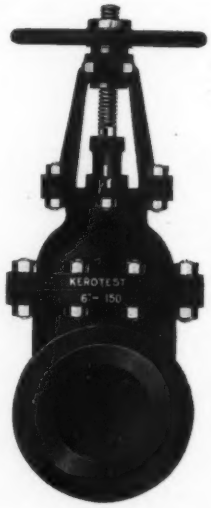

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Oklahoma Refiner to Seek Reopening of Mid-Continent Rate Case

Carrier executives asked to defer putting new tariffs into effect until action is taken on petition

By Grady Triplett

Tulsa, Oklahoma.—Oklahoma refiners have begun action seeking either revocation or a change in the findings of the Interstate Commerce Commission of June 30, whereby rates on petroleum were increased and the differential between groups 2 and 3 widened. The whole course of action has not been determined. But the first move is that of filing a petition, asking for a reopening of the case.

At the same time, executives of the carriers are being asked to defer putting the new tariffs into effect until action is taken on this petition for reopening.

Decision to seek a reopening of the case was taken at a recent meeting in Tulsa. Officials of representative refining concerns of Oklahoma as well as traffic executives attended this. In case the Interstate Commerce Commission fails to reopen the case, which it has power to do, some other course will be taken up, for Oklahoma refiners are bent on opposing the latest petroleum rate decision in every possible way.

Seekinb Relief

It is the contention of Oklahoma refiners that the higher differential placed on petroleum shipments from group 3 into western trunk line territory will result in crippling the refining industry in Oklahoma. On that score it is possible that both civic and political organizatios of the State will be enlisted in the effort to bring a reduction in the rate increase that will come with the adoption of the Commission's findings by the carriers.

That the situation is a serious one with Oklahoma refiners is borne out by the fact that concerns having plants near the Kansas line are now having estimates made on providing loading facilities in the latter state. Both pipe lines and industrial railroads are being considered as means of allowing Kansas loadings, and the consequent lower freight charges to the Middle West.

It is estimated that the petroleum products shipped out of Ponca City, for instance, could move at $300,000 lower freight charges annually, if loaded in Kansas rather than Oklahoma. This figure is set under the condition of the new tariffs becoming adopted by the carriers. Loading facilities 25 miles in length would allow Kansas loading in this case.

Blackwell is closer than Ponca City. Enid is 40 miles from the State line. Nowata is another point near the line dividing the states.

Differentials Certain

Projects of this sort are but rare possibilities. Only preliminary consideration is being given them. Only the larger of the refining centers of this class could afford such a venture. The fact, however, that even scant consideration is given such is an indication of the position Oklahoma refiners believe they are facing.

Findings of the Interstate Commerce Commission do not compel carriers to adopt the higher rates. But the increased differential must be adopted voluntarily, or the Commission will issue an order forcing the railroads to put it into effect.

It is the wider differential that Oklahoma refiners consider certain to prove harmful to their business. Regardless of rates, they believe the wider differentials given the Kansas group will result in stifling the refining industry in Oklahoma.

It is the custom of Kansas refiners to sell in Western Trunk Line Territory at the price prevailing in Oklahoma. Any lower freight rates existing result in that much profit to the Kansas shipper. Present tariffs give Kansas refiners differentials to several of the points in Middle Western territory. But the points are so few and the differentials so slight that group 3, or Oklahoma, has been the price making group since 1915, when the present tariffs were established.

If reports are true, Kansas refiners are hopeful of continuing to sell at group 3 figures under the newer tariffs. By doing that, the increased differentials will allow still wider profit margins on their shipments.

Looking Ahead

But Oklahoma refiners see in the proposed tariffs a change by which Kansas, or group 2, will become the price making territory. Instead of gasoline being sold at Oklahoma refinery prices and Kansas refiners enjoying higher profit in some instances, Oklahoma refiners see the time when prices will be made on the group 2 basis, forcing Oklahoma refiners to sell at the Kansas prices and suffering whatever loss may occur through the higher freight rates.

Gasoline manufactured in Kansas is small compared with that produced in Oklahoma refineries. So on the score of amount, Kansas can not become the price making group. But Oklahoma refiners are fearful of a time when there is "distress" gasoline over the whole Mid-Continent. Then, in order to sell at all, they believe Kansas refiners will surrender their rate differential profit to the jobber, which will put Kansas in the price making class, leaving Oklahoma gasoline to meet the lower price to find any market in Western Trunk Line Territory.

And that, in the opinion of Oklahoma refiners, will mean the gradual diminishing of the refining capacity of Oklahoma. Any new refining capacity built will not be in Oklahoma but in some territory favored by lower rates.

But the Oklahoma refining executives do ot expect Kansas to profit from such a shift in gasoline making centers. They believe refineries will move into the Middle West or to the Gulf Coast or Atlantic seaboards, where full advantage may be taken of rates.

Such, of course, will force movement of crude oil through pipe lines to new or enlarged refining centers in these districts, whereas the present state is that gasoline moves by rail to distributing centers.

Present Building

In support of this, they point to the fact that under existing conditions the refining capacity of Chicago, St. Louis, the Atlantic Seaboard and the Gulf Coast is being increased, while little in comparison is being done toward increasing refining capacity of the Mid-Continent.

Until Oklahoma refiners progress in their effort to prevent the rate change, the position of Kansas refiners will not be known. It is likely, however, that the two groups will line up against each other in this battle of rates.

For rate purposes, the districts are known as groups 2 and 3. Geographically, however, it is Kansas and Oklahoma. Group 2 includes each refining center of Kansas. Group 3 includes each refining point in Oklahoma, except Devol, which is grouped with North Texas for rate purposes.

These groups are the result of findings of the Interstate Commerce Commission in 1925. Prior to this time petroleum rates from the Mid-Continent to Western Trunk Line territory were somewhat jumbled. At that time Kansas refineries were located at Coffeyville, Chanute, Erie, Humboldt, Neodesha and a few other points.

History of Groups

Originally Oklahoma's refining center included such points as Chelsea, Vanita, Glenpool, Bigheart (now Barnsdall), Muskogee, Okmulgee, Sapulpa,

Destination Key Points	Rates from Kansas Group 2				Rates from Oklahoma Group 3				Differentials Kans. under Okla.			
	Pres.	New	Inc.	Red	Pres.	New	Inc.	Red.	Pres.	New	Inc.	Red.
Kansas City, Mo.	17.5	20.	2.5	..	24.	27.	3.	..	6.5	7.0	0.5	..
Des Moines, Iowa	30.	29.5	..	0.5	33.	33.	..	..	3.0	3.5	0.5	..
Cedar Rapids, Ia.	33.	33.	..	..	34.	35.5	1.5	..	1.0	2.5	1.5	..
Fort Dodge, Iowa	36.	34.	..	2.	38.5	36.6	..	2.	2.5	2.5	..	..
Mason City, Iowa	38.	36.	..	2.	40.	38.	..	2.	2.0	2.0	..	..
Omaha, Nebraska	29.5	29.5	..	..	33.5	33.	..	.5	4.0	3.5	..	.5
Lincoln, Nebraska	29.5	29.5	..	..	33.5	33.	..	.5	4.0	3.5	..	.5
Sioux City, Iowa	36.	33.5	..	2.5	39.5	36.	..	3.5	3.5	2.5	..	1.0
Sioux Falls, S. D.	43.	38.	..	5.	43.	40.	..	3.	..	2.0	2.0	..
St. Louis, Mo.	29.5	30.	0.5	..	29.5	32.	2.5	..	..	2.0	2.0	..
Keokuk, Iowa	31.	31.5	0.5	..	31.	33.5	2.5	..	..	2.0	2.0	..
Dubuque, Iowa	34.	36.	2.0	..	34.	38.	4.0	..	..	2.0	2.0	..
Peoria, Illinois	33.	34.	1.0	..	33.	36.	3.0	..	..	2.0	2.0	..
Chicago, Ill.	36.	37.	1.0	..	36.	39.	3.0	..	..	2.0	2.0	..
Milwaukee, Wis.	39.5	40.	0.5	..	39.5	42.	2.5	..	..	2.0	2.0	..
Wausau, Wis.	44.5	44.	..	0.5	44.5	46.	1.5	..	..	2.0	2.0	..
St. Paul, Minn.	43.	40.	..	3.0	43.	42.	1.0	..	..	2.0	2.0	..
Duluth, Minn.	49.	45.	..	4.0	49.	47.	..	2.0	..	2.0	2.0	..

Tulsa and Ponca City. It is interesting to note that several of these points no longer have refineries.

Group 2 now includes points in Kansas as far west as Hutchinson, while group 3 has grown to include Enid, Oklahoma City and Ardmore.

Western Trunk line territory may be described as Nebraska, South Dakota, North Dakota, Minnesota, Iowa, Wisconsin, the northern Peninsula of Michigan and the western part of Illinois.

While it is not known on what grounds Oklahoma refiners will seek reopening of the case, it is known that some men of the state believe any consideration of Mid-Continent petroleum rates should have included possible regrouping of territory.

They point to the fact that refining centers of Western Kansas are farther removed from Kansas City and St. Louis than are refining points in Northeastern Oklahoma. Under the proposed tariffs these Oklahoma points come under a higher rate than this class of Kansas points.

Destination Key Points	Av. Distance From Kans. Group 2	Av. Distance From Okla. Group 3	Differential Kans. under Okla.
	Miles	Miles	Cents
St. Louis, Mo.	394	448	..
Chicago, Ill.	606	704	..
Milwaukee, Wis.	666	776	..
La Crosse, Wis.	..	..	..
St. Paul, Minn.	637	744	..
Winnipeg, Man.	1.101	1,208	..
Des Moines, Ia.	361	461	2.5
Omaha, Nebr.	344	449	3.0
Sioux City, Ia.	..	..	3.0
Kansas City, Mo.	150	251	5.0
Joliet, Ill.	..	..	..
Springfield, Ill.	..	..	..
Sedalia, Mo.	..	..	..

Oklahoma refiners also point out that there is a wider territory grouping in refining districts within that State than there is between some of the refining centers of Oklahoma and Kansas. The territory around Okmulgee marks the end of one part of the Oklahoma territory. It is 150 miles from this rim of refining district to that around Ardmore.

No such distance exists between Coffeyville, Kan, and Tulsa, Okla., for instance; or between Arkansas City, Kan., and Ponca City, Okla. At other points territory in Kansas and in Oklahoma is closer by miles than is that roughly described as Northern and Southern Oklahoma.

Should the Interstate Commerce Commission reopen this case, it is likely to take a long period for its final settlement. If it is not reopened, Oklahoma refiners have yet to seek other means of preventing adoption of the revised tariff schedules.

This table shows average distances determined by the Interstate Commerce Commission for groups 2 and 3 to the key points in destination territory, together with differentials, Kansas under Oklahoma in the case of Mid-Continent Oil Rates 1915.

Rates proposed under findings of the Interstate Commerce Commission June 30, 1925, from the two groups of origin to destination key points with differentials, Kansas under Oklahoma, also the new rates found reasonable by the Commission, are shown in this table.

Open Meeting of W. P. R. A. Technical Body Forecasts Other Sessions

Ponca City, Oklahoma.—Success of the first meeting of the technical committee of the Western Petroleum Refiners Association as an open forum is likely to result in regular meetings of this nature. The first meeting was held here July 13. Another is in prospect for fall, with Wichita Falls mentioned as the place.

Refiners superintendents, chemists and others met for this first meeting. The chief events of the day were inspections of the plants of the Marland Refining Company and the Empire Refineries Inc., which recently have undergone improvements and additions. In each instance, the new equipments and its use was outlined by an executive of the company.

Previous to the refinery visits a meeting was held in the office of Walter Miller, vice-president of the Marland Refining Company. C. L. Henderson of the Vickers Petroleum Company, Wichita, Kansas, vice-president of the Western Petroleum Refiners Association and chairman of the technical committee, called the meeting to order.

He then introduced H. W. Camp, general superintendent of the Empire Refiners Inc., who gave a description of the manufacturing process of his company's plant at Ponca City. Later Mr. Camp and R. R. Mills, superintendent of the Ponca City plant, conducted the visitors through the plant. Its equipment was explained in detail.

At a luncheon at the Jens Marie hotel, Walter Miller related the program of expansion at the Marland plant at Ponca City. This was followed by a trip of inspection through the Marland plant.

Then the visitors returned to Mr. Miller's office, for a general discussion. It was then decided to hold another such meeting in the fall and Wichita Falls was suggested as the place for it.

This meeting and the promise of others are the outgrowth of the technical parts of the programs of the last two conventions of the Western Petroleum Refiners Association.

Among those present were Howard Bennette, general manager of the association; C. L. Henderson, vice-president of the association and also vice-president of the Vickers Petroleum Company, Wichita; H. W. Camp, general superintendent and R. R. Mills superintendent of the Ponca City plant of the Empire Refineries Inc.; Walter Miller, Wayne P. Rice, H. G. Osborne and C. E. Isaacs of the Marland Refining Company, Ponca City; K. J. Smith, Skelly Oil Company, Eldorado, Kansas; A. M. Schrepfer, Vickers Petroleum Company, Potwin, Kansas; P. E. Slater and E. J. Slater of the Champlin Refining Company, Enid; C. A. Davis, Peerless Refining Company, Chanute, Kansas; W. F. Sims, Panhandle Refining Company, Wichita Falls; Frank Hovell, Grayburg Oil Company, San Antonio; D. A. Dean, Oil State Refining Company, Enid; E. L. Kitheridge, Fairmount Refining Company, Enid; Sayvester Dayson, Lion Oil Refining Company, El Dorado, Arkansas; C. S. Durham, W. O. Keeling and Charles C. Durkee, White Eagle Oil & Refining Company; W. C. Long, Golden Rule Refining Company, Wichita; O. S. Ambrose, Tidal Refining Co, Tulsa; and F. M. Floyd, Oriental Oil Company, Dallas.

Panhandle Crude Requires Special Operating Practice

High sulphur content demands change in usual method and equipment

By Roye Munsell
Staff Representative

TEXAS Panhandle crude from Carson and Hutchinson counties is, apparently, a rather difficult problem any way you look at it. By virtue of its high wax and lube content it gives the producer and the pipe line operator much trouble because it requires special handling to keep it liquid during periods of low temperature.

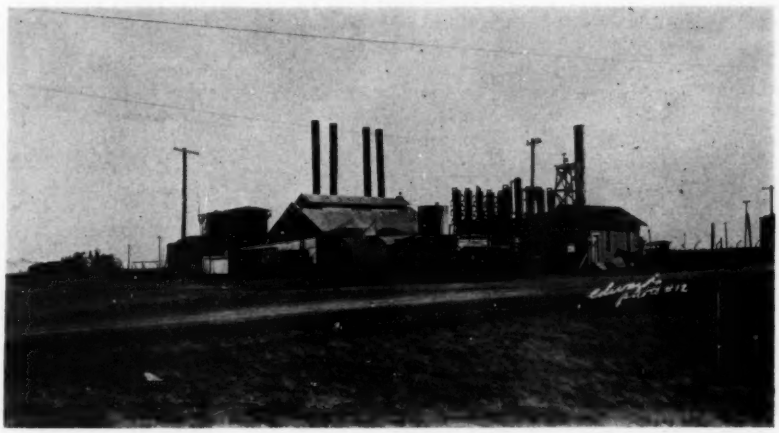
From the standpoint of the refiner, a sulphur content, which is not only high, but seemingly of a peculiar nature, means trouble. The sulphur runs from 1 to 3 per cent, and will average somewhere near 2¼ per cent.

To date, it might be said, very little Panhandle crude has found its way to Mid-Continent refineries, and this is in spite of the fact that the field has already produced 5.000,000 barrels of oil, and is now going at the rate of 80 000 barrels daily.

Most of the field's production has gone into steel storage, either in the field or close by. The small proportion that has gone out has been by the way of tank cars.

Despite the above figures on total production and daily average production, the field is without a pipe line outlet. Neither does it have the apparent prospect for one to be put into operation before the early part of next year.

As it was mentioned above, the high wax and lube content of the crude presents a special problem of handling. The oil begins to congeal into an immovable mass at around 50 degrees F. To get the real significance of what this means, it must be recalled that the winters out in the Panhandle country are long and rather cold, the temperature frequently getting below 50 degrees F. and staying that way for long periods at a time.



Plant of the Amarillo Refining Company which has operated two years on Panhandle crude. Fig. 1.

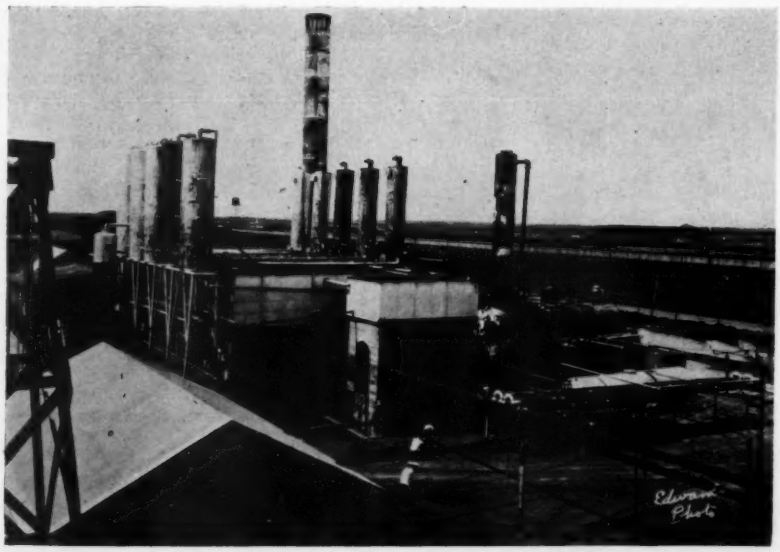
Probably the greatest deterrent to the entry of a pipe line into the field has been the lack of a practical solution of the problem of keeping the oil fluid during low temperatures. It can be expected that no pipe line will attempt to move the oil from the field until a solution of this problem has been satisfactorily worked out.

The congealing properties of Panhandle crude has little, if any, special concern to refiners, except that it will tend to cause refineries to be located in or near the field.

The only plant now in operation in or near the field for running Panhandle crude is that of the Amarillo Refining Company, located at Amarillo, Texas. Another is in the process of completion, however, near the town of Borger, in the heart of the field, by the Amarillo Producers and Refiners Corporation, and others are contemplated. The plan seems to be to erect small, comparatively low cost plants that will pay themselves out in a short period of time.

In the few cases in which refineries have attempted to run Panhandle crude by their present operating methods and equipment for other Mid-Continent oils, it is reported that in the most instances they were unable to handle the oil with much success. This was largely because of the high sulphur content of the crude, which presented a situation and a special problem with which they were unfamiliar.

As has already been mentioned, the crude averages around 2¼ per cent sulphur, which in the process of refining is converted into free sulphur, hydrogen sulphide and other sulphur compounds, all to cause excessive cor-



Tower and still instillation at the Amarillo Refining Company plant. Fig. 2.

rosion, special treating and other operating difficulties.

All of this is not to say that Panhandle crude is necessarily bad from the refiner's standpoint, rather, it is difficult. It means that new plants to be built to handle this oil, as well as present plants already built for handling other crudes, must be changed more or less as to process and practice from the customary mode, apparently, if they are to operate with any degree of success.

It is significant to note in this connection that other crudes, which at one time looked a great deal worse, are now considered perfectly good refinery stock by virtue of the special processing and equipment that has been adopted.

Probably the biggest problem in handling Panhandle oils is that of treating. After two years of operation on Panhandle crude, the Amarillo Refining Company has worked out a process at their Amarillo, Texas, plant that seems to meet the requirements of the oil. The process is the result of much experimentation by G. L. Rowsey, the superintendent, who has pioneered in the handling of Panhandle crude through a refinery.

Instead of going into the design of the Amarillo refinery, it might be best to deal most with the process employed for treating, since it is a solution to the paramount problem encountered in the processing of Panhandle oil.

As regards the plant, suffice it to say, at this time, that it is of the skimming type with a 4000-barrel capacity. Distillation is made with one tube still and five 10x30 shell stills. A result of this practice of using a shell still and a tube still side by side has led to the opinion by the operators that the tube still is much better suited to the running of Panhandle oils. In the case of the latter, not only is greater efficiency of distillation secured, but fuel, maintenance and other operating costs are appreciably lower.

The products recovered by the Amarillo Refining Company from Panhandle crude are a 64-66, 375 E. P. export gasoline, a 450 E. P. naphtha, a 40-42 gravity distillate and an 80-90 cold test gas oil.

The gas oil, it is reported, makes an excellent charging stock for a cracking plant, and will eventually be used as such, no doubt. The Amarillo Refining Company, it so happens, is able to dispose of their supply, in spite of its high cold test, to a railway company for fuel.

No kerosene is made, it will be noted. This is because the treating costs with any known process make its manufacture as such commercially not worth while. A method is being experimented with now, however, by the management on a small scale which may prove to be profitable on a commercial basis. It involves the use of specially prepared clays, since treating for color offers the greatest difficulty.

Operating on 36 gravity Panhandle crude, the proportion of 375 E. P. gasoline runs about 25 per cent, the high gravity naphtha cut 4 per cent and the distillate 10 per cent, the balance being gas oil, etc.

By combining the gasoline and naphtha cuts, a 410 E. P. gasoline is secured, which brings the ultimate recovery of marketable gasoline up to about 29 per cent.

Many methods of treating gasoline were used by the management before the present one was finally worked out. The customary sulphuric acid and sodium plumbite process is inadequate, as is the newer hypochlorite of soda method, apparently. In neither case would the product hold its color or meet the copper strip corrosion test.

In the process being used, the gasoline is first given a preliminary wash with caustic soda to remove the hydrogen sulphide.

$$2\ NaOH + H_2Na_2 + 2H_2O$$

Instead of considering the sodium sulphide (Na_2S) as a waste product, it is further utilized in the treating process by converting it with litharge into lead sulphide, which is also used as a treating agent.

As the sodium sulphide is drawn off from the washing chamber, it is run into another chamber where the litharge is added. As the lead sulphide is precipitated, it is allowed to settle, and then removed and washed by decantation.

The reaction by which the lead sulphide is formed is probably as follows:

$$PbO + 2\ NaOH = Na_2PbO_2 + H_2O$$

(As the Na_2PbO is formed the following takes place:)

$$Na_2PbO_2 + 2H_2O + Na_2S = PbS + NaOH$$

By using an excess of caustic soda in the preliminary wash there is an excess of caustic soda in the solution drawn off, which reacts with the litharge added to form sodium plumbite, which in turn reacts with the sodium sulphide present to form lead sulphide.

As the lead sulphide is formed, it is removed and washed, as has already been mentioned. Then it is charged with the partially treated gasoline into a series of mechanical mixers, where the two are forced into intimate contact.

The apparatus used consists of four 12-inch tubes, 12 feet long, each equipped with mixing blades. From these tubes the gasoline and lead sulphide are run into an old style agitator that is used for settling out the lead sulphide. After leaving this chamber the gasoline is sweet and better than 30 color.

What the further action produced by the lead sulphide consists of has not been fully revealed. Part of it is probably due to the absorptive properties of the "wooly" precipitate of lead sulphide. The complete action, apparently, goes further than this. Some action will be gotten, it is evident, if free sulphur happens to be present.

The treating process is continuous all the way through, and causes a loss of less than .5 of 1 per cent. Three hundred barrels may be handled through the treater per hour it is claimed.

About 200 pounds of caustic soda per 1000 barrels of gasoline is used for the preliminary wash. To secure the lead sulphide for the final treatment, about 100 pounds of litharge are necessary per 1000 barrels of gasoline. The small amount of litharge used is because the lead sulphide after it is once formed may be used several times.

Of particular interest to operators, probably, would be the amount of corrosive action on equipment caused by running Panhandle crude.

Before going into that, it ought to be mentioned first that the oil has associated with it about 2 per cent salt water, which is, by the way, about 1 per cent more than a good centrifuge test shows.

This situation, of course, adds to operating difficulties. At the Amarillo plant the oil is heated to 250 degrees F. and run into a settling chamber before it reaches the stills, in order to remove the most of the water. A goodly proportion, however, remains, which is enough, when the oil gets into the stills, to cause trouble by the formation of hydrochloric acid and other corrosive chemical compounds.

Only a small amount of the acid gets over from the stills, but what does, added to the sulphur, is a serious source of corrosion. Steel condensers would not last the time that it took to install them, probably. When pipe coils were used at the Amarillo refinery they had to be replaced about every two weeks.

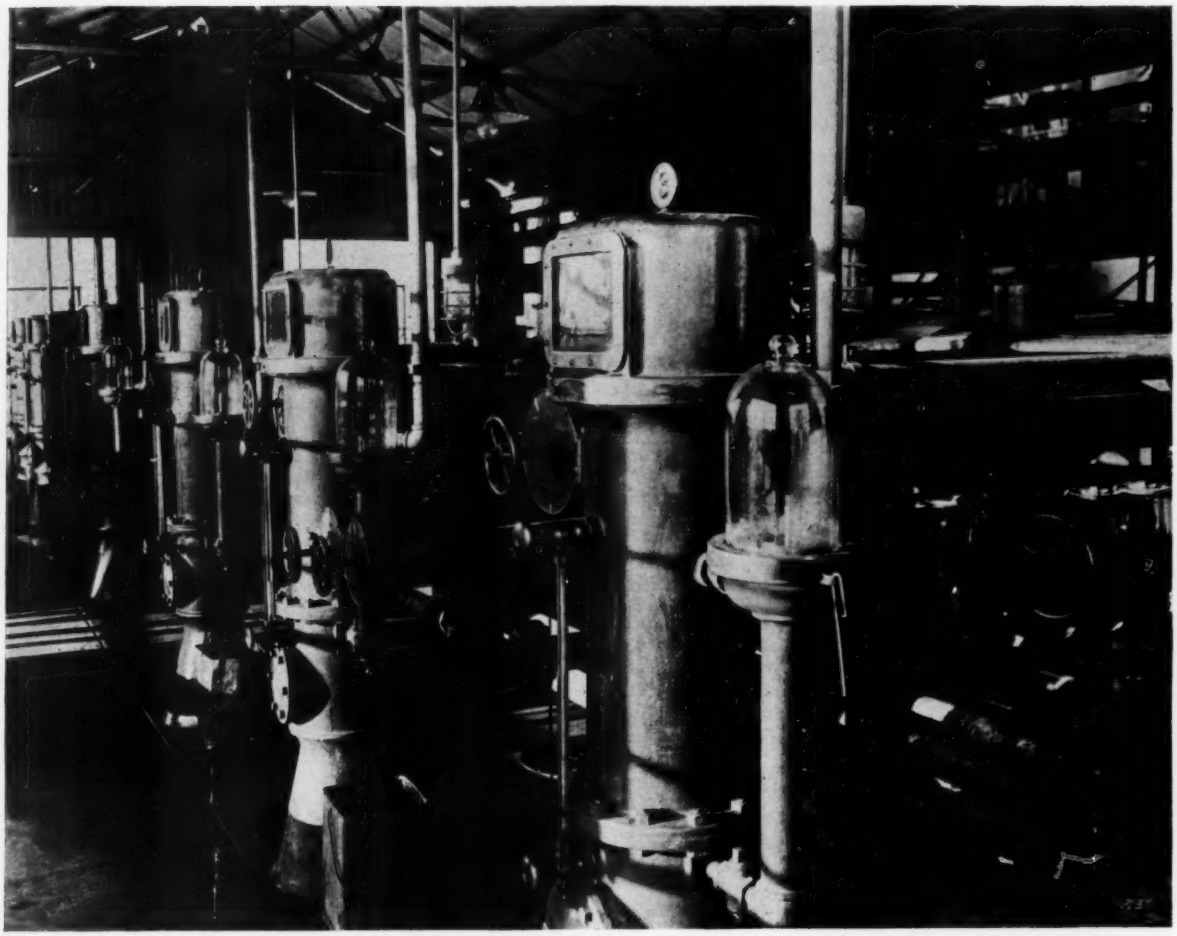
The final installation of cast iron Sterling sections has gone a long way in the solution of the problem of corroded condensers, since they have been found to last about a year.

Thirteen Sterling units, 10 sections to the unit, are being used. They are so connected that one may be removed for repair or replacement without interfering greatly with the operation of the plant.

This is accomplished by having the vapor line so hooked up that by the mere manipulation of two valves any unit may be cut out temporarily.

A part of the salt in the water, of course, crystallizes out in the stills and accumulates there. From time to time they must be cleaned out. The salt accumulations are removed by flushing with hot water, which readily dissolves the salt. Any sand which settles out of the oil and remains in the stills is carried out during the cleaning process.

In the case of the shell stills, they are shut down about once a month for cleaning. In the case of the tube still, the intervals between cleaning are about ten days.



Hydrometer well devices for constant gravity readings are in the foreground of this view of the receiving house at the Richfield plant

Richfield Refinery Core of Complete Oil Company Unit

Special receiving house equipment for control draws attention from engineering view

By George Reid

THE successful attainment of a complete and independent economic unit is the ideal or end toward which many oil producing and refining organizations are constantly striving. A complete economic unit as pertaining to the petroleum industry embraces practically the same qualities and conditions as those found in other major industries of the business world, namely; the control of the raw material at its source, the efficient, and especially in the oil industry, the scientific, manufacture of the finished products, and the general distribution of those products manufactured by the organization.

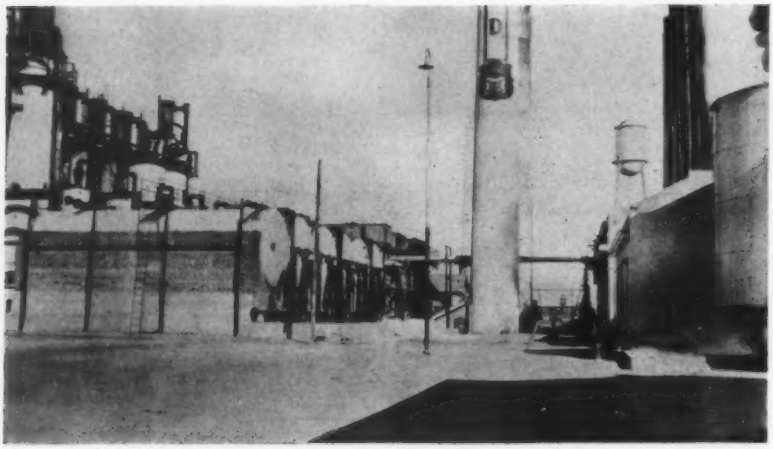
The complete economic unit in the petroleum industry embraces many items of importance. First, the production of crude oil is paramount and includes ownership of producing wells, gathering systems and pipe line facilities. Second; the refinery which must consist of scientific and efficient equipment, preferably located on a site convenient to the company's producing properties, with due consideration also given to the proximity of the prospective marketing territory. Labor, adequate water supply, railway facilities, and electricity, usually require some consideration, when the choice of site is made.

Another item of certain importance which has lately come into prominence in conjunction with the manufacture of gasoline is the adequate supply of natural gasoline for blending purposes at the refinery. Usually this supply must be guaranteed by the installation and operation of efficient natural gasoline plants, preferably manufacturing gasoline from the company's owned producing wells.

The third important phase of the economic unit is that of distribution or marketing the products manufactured by the company and in the oil industry this involves the ownership of centralized distributing stations in connection with a well established chain of service stations where the principle products of the refinery are dispensed to the individual motorist.

Self Dependent

On the Pacific Coast territory, the Richfield Oil Company is one of the outstanding organizations whose oper-



Plant of Richfield Oil Company, Hynes, California

ations include the necessary activities that it may be truthfully termed a complete economic unit. In this discussion, however, the departments of crude oil production, pipe line, natural gasoline manufacture and distribution or sales, will be dealt with in detail, but the discussion will be limited to the description of the company's 27,000 barrel daily capacity refinery at Rioco, (Hynes), California. Like a circle within a circle, this plant is dependent upon nothing outside of the single company organization. Perhaps the most fitting term would be—a complete and independent part of an established economic unit.

In choosing this site at Hynes some years ago, the company located the plant about five miles inland, east of the Signal Hill oil field, which site assured the plant of all the necessary facilities, railroad connections, labor proximity to both crude production and the market for their products.

In the construction of the plant every possible item of importance tending toward making the successful operation of the property independent of outside influence was given careful consideration. The continuous operation of the refinery is assured by the delivery of crude petroleum directly to the company's tank farm on the refinery property, and this oil is transported through the company's own pipe line from their own producing wells. As a consequence the plant is operating on a mixture of crude from Signal Hill, Dominguez, Athens and Rosecrans.

Again, the matter of a constantly available supply of water for evaporation or power purposes, and condensation, is assured by the maintenance of water wells drilled on the plant site. The water is converted into steam for refining and power purposes in the centrally located power plant, which consists of six, 300 horse power, Foster marine type boilers. Water for condensation purposes is pumped through condensers of the Southwestern type, conducted to large Louvre cooling towers, some 40 feet in height, where it is cooled in its descent, for re-use.

Generate Electricity

Important saving in electricity costs, and independence of outside sources of electricity, is assured through the installation of a complete electricity generating plant. This unit consists of two 350 kilowatt Westinghouse generators which are driven by direct connected steam turbines. The plant operates continuously, generating electricity at 440 volts which is employed for operating electrically driven centrifugal pumps and other equipment. This type of pumping equipment is used for transfering water, light and heavy oils about the plant and for operating pipe line pumps. Transformers are used to "step down" the electricity from 440 volts to 220 volts for lighting purposes.

Residue, or lean gas, is piped to the refinery from the company's nearby natural gasoline plants, for use in firing the boilers and stills. A certain proportion of this fuel is derived from the gasoline recovery plant located on the refinery yard, this recovery system producing gasoline from the gases from the Cross cracking units and refinery receiving house, gasoline tanks, etc. Fuel costs at this refinery are said to be very low.

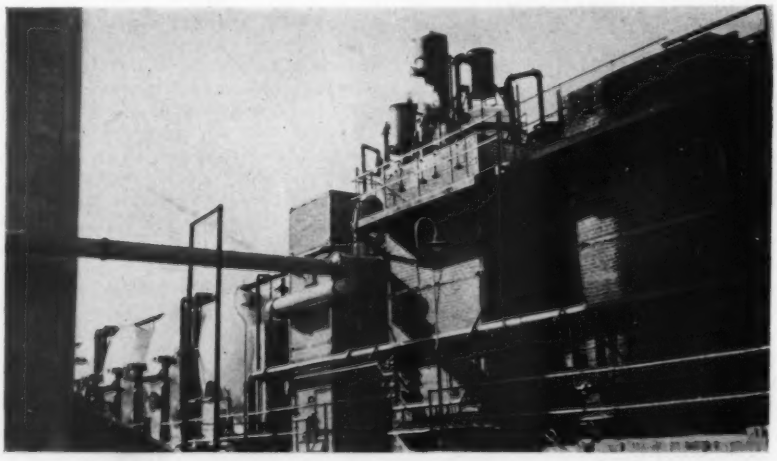
Just as the incoming raw material, crude oil, is conveyed to the refinery through the company's own pipe lines, so is the distribution of the products of manufacture handled practically independent of outside transportation facilities, for the company distributes fully 75 per cent of its finished product by pipe line.

The main pipe line for gasoline runs from the plant at Hynes to the bulk station or distributing plant, on Twenty-fourth street, Los Angeles. From this station it is handled by tank trucks and delivered to the numerous consumers. The bulk station on the refinery grounds is also the distributing point for a certain amount of finished products. A large pipe line running from the Hynes plant to the Los Angeles harbor transports most of the fuel oil produced, to that point for marketing. A second line, paralleling this fuel line conveys gasoline to the harbor where it is loaded into tankers for shipment to the northern territory.

Distillation Equipment

As described above, the plant is operating practically independent of outside influences, supplying itself with the auxiliaries of light, power, fuel and water, and being dependent only upon other departments within the same organization for its raw material and the removal of its products.

Three large Foster tubular retorts perform the major portion of the work of distillation. Each retort operates independent of the other, though the stills function simultaneously in the work of heating the crude oil. The installation is in line with the trend of progressive refiners; who refine oil by means of tubular heating units in conjunction with efficient fractionating columns. Such installations are becoming more and more frequent in the refining industry as they are more compact in design, requiring much less space, more efficient in the separation



Foster tubular retorts and steam super-heaters

of cuts, due to improved dephlegmators or selective rectifying columns; and much less fuel is consumed in attaining the advantages of higher charging rate, or capacity, and closer fractionation, due to the higher thermal efficiency of the tube still.

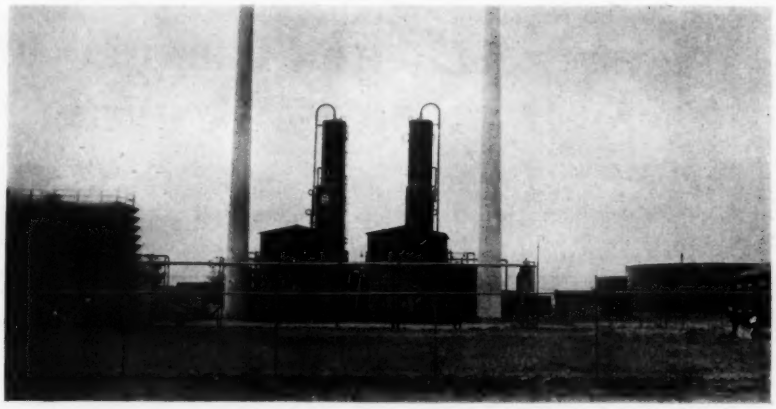
The tube stills are utilized as the heating elements of separate distillation units, each being complete in itself; and the products of the operation are received separately after condensation, to be combined, usually, in one rundown tank for further treatment or handling. Since each unit performs in a manner similar to the other two units, it is necessary to describe but one operation here. The incoming cool crude is first charged to a series of four Southwestern heat exchangers, where the crude flows counter-current to the hot residuum leaving the separator. Crude oil is charged by Quimby screw pumps operated by Terry steam turbines; passing through the exchangers, where the temperature is materially increased, usually to about 240 to 275 degrees F. From the exchangers the crude is conducted to a combination evaporator and bubble tower. The partially heated oil enters the evaporator about midway of its height, to be broken up into numerous streams, or layers, as it descends over specially designed baffle equipment, to the bottom of the evaporator.

At times, superheated steam is employed in the separator for the purpose of maintaining the temperature, or possibly increasing it some, and to keep the oil in constant agitation, also for the purpose of assisting in the separation of the lighter gasoline vapors at this point. During the time of flow through the vaporizer or separator, the crude is stripped of the greater portion of its gasoline vapors. The volume removed here is naturally governed by the characteristic of the crude oil being charged. Probably 50 per cent or more of the total gasoline content is vaporized and condensed in this operation. This is in line with the usual results secured where exchanger streams are taken off the crude while it is en route to the stills.

The crude is again handled by Quimby screw pumps, steam turbine driven, from the bottom of the separator-tower apparatus, to be discharged to the Foster tube stills. These stills are fired usually at a temperature of about 550 degrees F., or sufficient heat is applied to assure the vaporization of all of the desired fractions, and leaving a fuel oil residuum of the required specifications, 19 to 21 degree A. P. I. gravity, and approximately 275 degrees F.—O. C. flash.

Fractionating Equipment

The hot oil leaving the retort is conducted to a second separator, where it is handled in the usual manner, the vaporized portion leaving the top of the separator or evaporator and the residuum removed from the bottom of the chamber, conducted through the exchangers, cooled and pumped to storage.



Cross cracking units at Richfield plant

The vapors leaving the separator are then conducted to a series of bubble towers. The fractionating towers are the Walter E. Lummus type, and resemble very much, the fractionating equipment of a modern, efficient, alcohol distillery, and this installation is equipped with a very similar system of control features. In these bubble plate columns, the remainder of the gasoline vapors are separated, and the heavier distillates which are collected as reflux condensates are either conducted to the series of six shell stills for redistillation and the preparation of special naphthas, kerosene, and stove oil, or they are brought through the receiving house as finished distillates or cracking stock for the company's two Cross units.

The Foster tube stills as employed in the operation briefly described above are handling about 25,000 barrels of crude oil daily. The removal of a large amount of gasoline from the crude in the primary separator, lessens, to a certain extent, the work of the tube stills and the fractionation equipment. Superheated steam is used freely in the distillation procedure on this plant, especially in the separators (vaporizers) and in the fractionating columns. The source of this steam, which is superheated in a large Foster heater, is the exhaust steam from the turbines, many of which, as previously mentioned, are used throughout the refinery for various purposes.

The receiving house at this plant is a point of interest in that it is somewhat unusual in the arrangement and type of equipment employed.

Control Equipment

The building might be better termed a combination control room and receiving house. Control instruments are extensively employed in the operation of the plant, and wherever the maintenance of constant temperature is of importance to the operation, a recording temperature controller is installed. All of the fractionation equipment, evaporators, reboilers, and similar apparatus are subjected to control as to temperature, and the recording charts of such instruments are all suspended on one centrally located board, on the wall of the receiving house. Certain of these instruments are merely indicators, such as still or retort, oil, furnace, and stack temperatures, such being regulated by the amount of fire under the still. An indicating pyrometer is also provided which, upon adjustment of the governing spindle, shows the temperature at various points about the distillation equipment, which are not of sufficient importance to require separate or individual recording instruments. With these indicating and control devices easily accessable through their central location, the plant operator is never in doubt as to the condition of his equipment.

The equipment provided for conducting the condensates through the receiving house and to the manifold is also of Walter E. Lummus type, and is quite different from that usually found in the refinery receiving house. In the picture illustrating the type of look boxes, control valves, and hydrometer wells, as installed, it will be noticed that at the front of the manifold and close to the look boxes, there are three 6 inch valve wheels. These wheels are attached to long stem valves and are used to control the action of the fractionating equipment, by regulating the volume of superheated steam entering into the Lummus bubble towers. Two of the valves regulate and control the superheated steam entering into the vaporizers or separators. With this arrangement and the nearby indicating and recording instruments as described above, the stillman easily controls the entire operation of the distillation equipment from his position in the receiving house.

Control in Receiving House

An item of particular interest in the receiving house is the dome-top vapor tight, look box, with the auxiliary vapor tight, glass covered receptacle in which the hydrometer is placed. This

(Continued on page 88.)

Soaking Drums Cleaned Mechanically By Rotary Drilling Method

Coke deposits yield readily to power driven equipment

By H. W. Fletcher
Chief Engineer Hughes Tool Company

As the consumption of gasoline increases the importance of the cracking process to the petroleum industry becomes correspondingly emphasized. The petroleum molecule is a complex structure built up of carbon and hydrogen atoms in various amounts. The relative number of carbon and hydrogen atoms in the molecule determines the characteristic of the compound, that is, whether it will be gasoline, kerosene, or heavier oil.

Most crude oils contain some gasoline which can be separated from the rest of the liquid by boiling at a low temperature and condensing the vapor, but in many cases the percentage of the gasoline originally in the crude is comparatively small.

Fortunately it was discovered that these complex molecules of the heavy oil could be broken down by the application of heat for considerable periods, evaporation being prevented by keeping the liquid under high pressure. Breaking down a given molecule in this way produces molecules both lighter and heavier than the original, and if carried far enough will result in the liberation of some solid carbon. As a result of this most ingenious process the greatly desired relatively light gasoline molecule can be "manufactured" from the heavy molecules of a crude originally containing practically no gasoline, and the industry has thereby been enabled to keep pace with the tremendous increase of gasoline consumption without a corresponding increase in the production of crude oil.

The production of solid carbon is an undesirable result of the cracking process as this carbon deposits in the form of coke inside of the cracking equipment, gradually filling up the space and requiring the cracking equipment to be periodically shut down and the coke deposits removed.

Time being an essential factor in the cracking process large chambers called "soaking drums" are provided in which the oil is maintained under a high temperature and pressure for a considerable period. These drums are often from 6 to 10 feet in diameter and 30 to 45 feet high, and may become filled with coke with greater or less density to a height of 20 to 30 feet.

It has been the practice in the past to hang a length of steel cable on small brackets inside the drum, winding it in a spiral from the bottom to the top of the drum, and consequently leaving it embedded in the coke when the run is completed. When the drum is shut off, has been steamed to remove combustible gases, and has cooled down sufficiently, the lower manhead is removed and this cable is dragged out with a tractor or hoisting engine and tears a considerable portion of the coke loose. It is then necessary to send men into the drum and finish cleaning by hand.

This cleaning system is rather unsatisfactory since it requires from 6 to 12 hours to cool the drum down sufficiently so that men can work in it, and the operation is very dusty and somewhat hazardous because of the danger of flashing of inflammable vapors from adjacent drums in operation. The actual expense of labor for cleaning is not so important, but the loss of productive time of the equipment is considerable, amounting in some cases to from 10 to 25 per cent of the total operating time.

The problem of coke removal from soaking drums was of particular importance at the Baytown refinery of the Humble Oil and Refining Company because of the large number of drums in service. This company decided to undertake the development of a mechanical cleaner for this purpose which would permit cleaning of the drums at higher temperature and perform the operation in less time, thereby reducing the lost production time during the cleaning operation, and called on the Hughes Tool Company of Houston, Texas, to design and build the equipment. It was decided to drill a hole upward through the coke, leaving a fairly thick layer adhering to the walls of the drum, and then in a second operation to remove this layer by beating it off with small bronze discs attached with chains to the top of a drill stem, the drill stem to be raised and lowered by hydraulic pressure and to be rotated by a small portable steam driven rotary.

The hydraulic cylinder illustrated in Fig. 2 consists of approximately 75 feet of 12½-inch casing set in the ground directly under the center of each soaking drum. Inside of this casing hangs a string of 10-inch casing about 66 feet long supported at its upper end on a Bradenhead making a fluid tight joint on the 12½-inch casing. The bottom end of the 10-inch casing is perforated and means are provided to introduce water under pressure between the 12½-inch and 10-inch casing at the surface. Inside the 10-inch casing is a piston on top of which rests the thrust bearing and drill stem, the latter being approximately 57 feet long for a 40-foot drum. When water pressure is admitted under the piston it raises the drill stem, and when water is allowed to discharge from the cylinder the weight of the stem carries it down again.

The drill stem consists of three lengths of 19-pound drill pipe welded together at the ends and provided with four driving ribs spaced 90 degrees apart, made of flat steel 1x2 inches and welded to the pipe the full length of the stem.

The rotary unit consists of a structural steel frame mounted on wheels running on a narrow gauge track on which is supported a 6-cylinder Baker Rotary steam engine of approximately

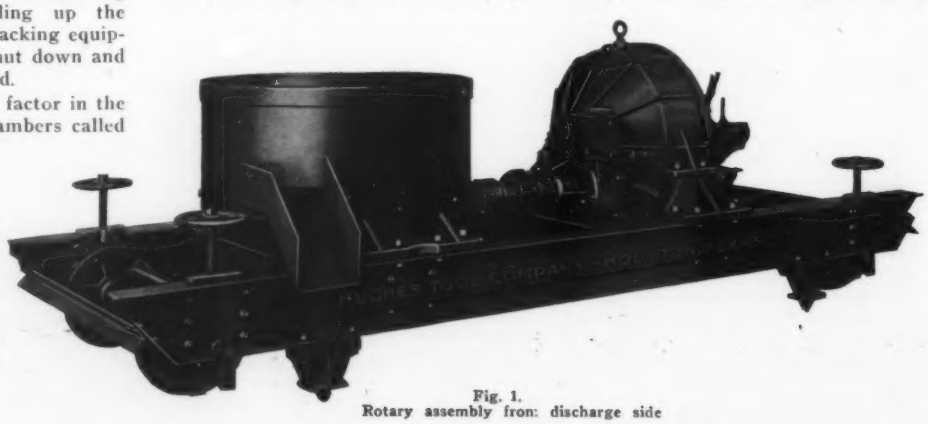


Fig. 1.
Rotary assembly from discharge side

25 H.P. direct connected through a flexible coupling to the pinion shaft of the rotary. The rotary is of all steel construction, runs on ball bearings, there being seventy 1½-inch balls in the table bearings, and is driven through replaceable heat treated cut gears. All moving parts are fully enclosed to prevent entrance of coke dust which would otherwise rapidly destroy the bearings.

The initial hole is drilled with a fish tail bit dressed to a diamond point for better centering and provided with two reaming arms producing approximately 36-inch hole. These arms are collapsible so that they may be entered through an 18-inch manhole opening. The second operation is performed with a bit as illustrated in the upper right-hand corner of Fig. 1. This bit has three hinged arms arranged to pass through the manhead and then open out, and on the end of each arm are two bronze discs carried on separate lengths of chain. When this bit is rotated, centrifugal force throws the discs out to the circumference of the drum and they rapidly beat off the layer of adhering coke.

The first step in the cleaning operation is to cut the drum off the line and steam it to remove inflammable vapors. The manheads are then removed and steaming continued. A small stream of water is also sprayed in which helps to cool the drum and remove the last traces of vapor. The rotary is then rolled along the track into position under the drum, and the hand wheels on the frame are unscrewed allowing the dowels shown in Fig. 1 to enter steel sockets set in the correct position in the concrete. This accurately aligns the center of the rotary with the center of the hydraulic cylinder and of the soaking drum. Water pressure is then admitted to the cylinder and the drill stem is raised through the rotary table and the driving bushings put in place. The fish tail bit is then screwed on to the top of the stem, the reaming arms are collapsed and the stem is slowly raised until the bit reaches the coke just inside the manhole. The stem is then rotated slowly, from 10 to 20 revolutions per minute, and as it is fed upward the bit cuts away the coke and the reaming arms expand to their full diameter. The coke cuttings pour down from the manhead and on to the rotary table which is enclosed in a stationary sheet steel hopper provided with an opening in one side and a small chute leading down to a pneumatic conveyor. Centrifugal force throws the coke toward the rim of the rotary table where a series of paddles attached to the rim drive it around the hopper and eject it through the chute into the conveyor which carries it to the bins in the boiler house or to the stock pile, as desired.

When this first hole has penetrated through the upper surface of the coke the drill stem is lowered, the fish tail bit is removed and the disc beater is attached to the stem. The arms of this second bit are then collapsed and it is introduced through the manhole and the arms drop down into position. This bit is rotated at from 60 to 65 R. P.M., and the discs are thrown by centrifugal force against the coke still adhering to the wall. This coke is of course, discharged from the rotary to the conveyor just as in the first operation.

The actual rate of drilling in the first operation in a 6-foot drum may be as high as two feet per minute, depending, of course, on the hardness of the coke, while the second operation may reach three feet per minute. The overall time for a complete cleaning operation on a 6x40-foot drum will average from one hour to an hour and a half, while a 10x45-foot drum has been cleaned in five hours. This corresponds to a reduction in actual cleaning time of from 70 to 90 per cent with a reduction in the shut-down time of from 60 to 70 per cent, as compared with the old method of pulling with a cable and finishing by hand. In addition, the operation is very much less hazardous, as it is unnecessary to send men into the drum at any time in the process.

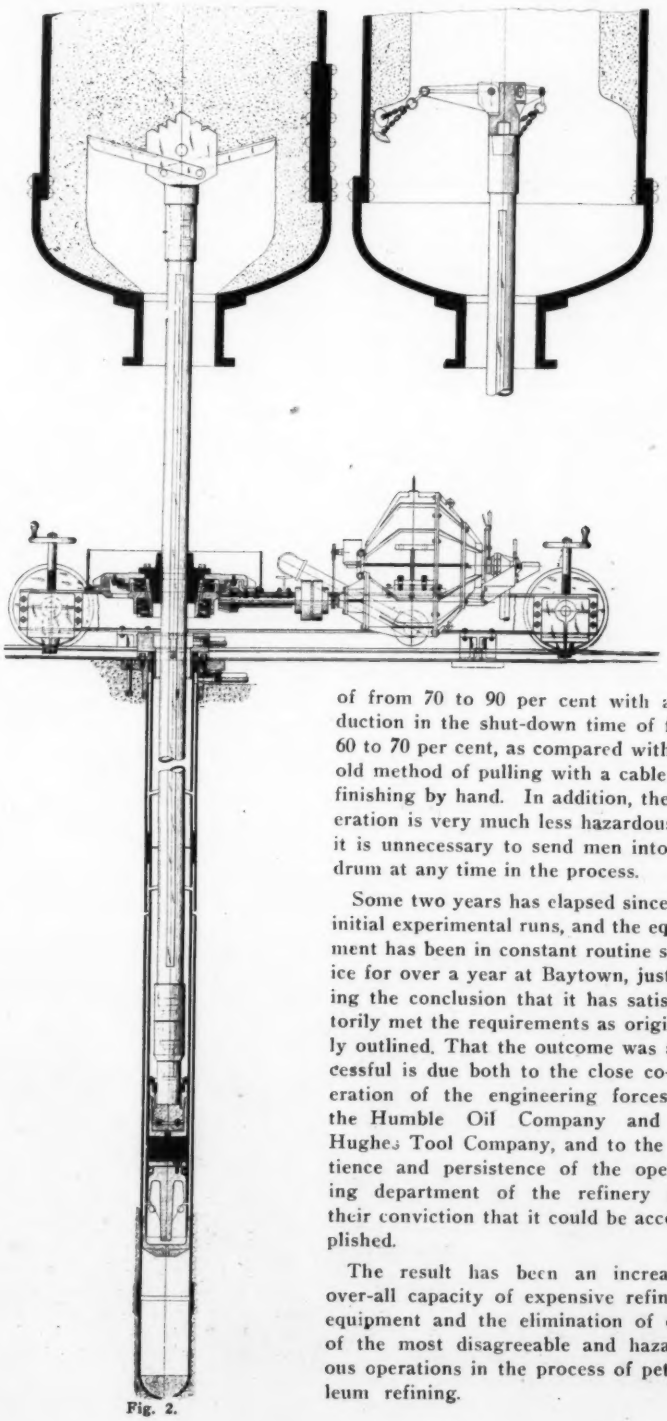


Fig. 2.

Some two years has elapsed since the initial experimental runs, and the equipment has been in constant routine service for over a year at Baytown, justifying the conclusion that it has satisfactorily met the requirements as originally outlined. That the outcome was successful is due both to the close co-operation of the engineering forces of the Humble Oil Company and the Hughes Tool Company, and to the patience and persistence of the operating department of the refinery and their conviction that it could be accomplished.

The result has been an increased over-all capacity of expensive refinery equipment and the elimination of one of the most disagreeable and hazardous operations in the process of petroleum refining.

Repair Procedure in Refineries

By J. A. Cruze

Master Mechanic, Shell Company of California, Wilmington Refinery

OIL refinery maintenance may sound to the unitiated like a very commonplace occupation, the rudiments of which any versatile chap could master after being shown once.

But the braggart who claims that he can do anything and everything inside a refinery fence is like the negro in Memphis who claimed he could "lick anything in Tennessee." He is covering a lot of territory.

Employes of the maintenance department of a modern oil refinery represent no less than 15 different trades. Any one of these at certain times and places is as indispenable as the other. From such an aggregation of trades come the principal hazards of industrial work, and the duty of safeguarding life and limb in a refinery is worth the best thought and concentrated effort of everyone concerned.

As a matter of fact, the bulk of refinery maintenance may be designated as pipe work and repairs to the various types of machinery. Such work, being more or less of a rough nature, offers the chance for the "unpreventable" type of accident at its best. For instance, bolts have been known to snap, chains and timbers to break. However, serious accidents in a refinery may be kept remarkably low, if the management shows the generous spirit in providing only the best in tools and equipment, and insists on educating the men along safety lines. From one week's time sheet, one may select several dozen different kinds of work. The greater portion of these are commonplace, and hazards engendered in their performance are negligible. There are a few among them, nevertheless, that merits discussion of special precautions in performance.

Manifold Repairing

A good example of such a case was the repair of a broken Tee in a gasoline manifold, in addition of which a dresser coupling had to be installed in order to take care of expansion. In a case of this kind, there is considerable loss of gasoline through the break, which makes fire the chief hazard. The old fittings have to be broken out, and the line cut to make room for the coupling. Usually there is not room to use pipe cutters and a hacksaw blade is resorted to. Use of an acetylene torch would mean suicide. A continuous stream of water should be played on the hacksaw blade as the line is cut for the coupling. The gang must be warned against making sparks in loosening or tightening flanges, nipples and the like, while brass hammers should be used if there is any hammering to do.

Welding Crude Lines

With reasonable precautions crude lines have been welded where there is no other fire hazard than the oil and gas in the line. There are several methods, though the following is considered the safest. If it is a welded line, a section is cut out with cutters or with the hacksaw as for gasoline, leaving space for either hub-nipples to be welded on the ends of the line and flanged together or valves and fittings inserted. The line now being cut, a few feet of the inside is swabbed clean with kerosene and rags, and a wooden disc with a rod bolted securely to its center is shoved into the pipe three or four feet. Next a mortar of mud, rags, or some other inexpensive but effective mixture, with a little asbestos near the weld, is packed against the wooden disc. The hub-nipple is fitted and welded to the line, after which a chain block is hooked on to the rod and the plug pulled out of the line.

Another safe method, much simpler when the material is at hand, is to insert a football in the line and then inflate it; covering the ball with mud or asbestos to protect it from the heat. Unless the job is extremely simple, it is considered the best policy to repair all welded pipe line breaks by installing the sleeve type expansion joint, which only requires cutting away the weld to permit the joint to slip.

Maintenance of fractionating apparatus presents serious hazards, like the failure of a valve to hold when cutting into a hot residuum line, condenser, or other apparatus. To guard against such hazards, flanges should be broken slowly; always leaving enough bolts to tighten the joint again in case anything went wrong. Most work of this nature is above ground on platforms and scaffolds, and wherever possible high sawhorses, though portable, should be built sturdy enough to support a sound and safe platform. The various temporary scaffolds should be discarded.

Tank Car Repair Tips

Receiving acid by tank cars may be termed "operation," however the maintenance crew is called upon to connect and disconnect the cars, which quite frequently calls for replacing of fittings and general reconditioning, necessitating workmen to be perched on top of the car or on loading rack. The chief danger of acid plant and agitator repairs is getting burned with acid. A very innocent looking fitting or pipe may be eaten to the point where the strain of a wrench on a bolt would break through the shell and start a leak. Acid plant workmen should be very careful not to work directly under a pipe or fitting being repaired, as any leak that might develop would cause the workmen to come in contact with the acid, which might cause painful burns, especially if any acid happened to get into the eyes. All workmen having occasion to work around acid should be furnished all-wool clothing and taught to use a neutralizing solution for acid burns.

Tank car repairs require greater caution, as the vapors inside an empty car are extremely explosive and far more dangerous than a tank full of gasoline. Before doing work on gasoline cars they are sealed top and bottom, or if the work is on the tank, a chemical solution is sprayed inside to remove all possibility of an explosion and the need of "flashing," as is a common practice in some plants.

In electrical maintenance, much can be done by the workmen to avoid accidents. The most common mishaps result from grounds, short circuits, burnouts, and such, where a spark or a flash is the cause. Ordinary electrical protection takes care of such cases by the blowing of a fuse or kicking out of a circuit breaker. In the refinery, where at any time there may be an explosive gas mixture present, steps must be taken to avoid these little accidents. In an ungrounded three-phase power system one of the lines may have an accidental ground which is not noticed until one of the other lines happens to touch ground in another place, resutling in a flash. A set of ground detector lamps, Y-connected with grounded starpoint will show up the first ground, before it has caused trouble. This is a simple method which may prevent most terrible accidents.

Another cause of fire is the wear of a motor bearing if it goes so far as to make the rotor rub against the stator. Frequent inspection of motors for oil and regular gauging of air gaps should prevent this. The use of belts should be avoided on account of the side wear on the bearing, and also the chance of static sparks. After disconnecting the direct connected centrifugal pumps with leather couplings, it is very important to have them connected so that the leathers are pulling and not pushing, causing endthrust and possible disastrous results. Arrows for rotation on all the pumps will prevent the electrician from reversing the motor.

Even a simple thing, like exchanging a broken lamp around the stills, is

(Continued on page 80.)

Rio Grande Plant Built For Permanence

Brick, concrete and steel supplant usual procedure of "temporary" buildings at first

IN the construction of the 4000 barrel skimming plant operated at Vinvale, California, by the Rio Grande Oil Company, nothing was omitted which would detract form the permanency and strength of the buildings, still settings and condenser box supports. Each building, regardless of its purpose, was constructed of brick or concrete, steel reinforced and tied with structural steel girders—assuring permanency. Often it is the case, that refining organizations first construct a complete set of temporary buildings, which, in the majority of instances are never removed as planned, but become the permanent buildings and lodgings of the company's manufacturing department to the dissatisfaction of all concerned. It is worthy of note therefore, that the Rio Grande, though building the Vinvale plant about three years ago, employed in the construction of the entire plant, the best of materials and engineering principles.

At the entrance of the 100 acre tract owned by the company some 8 miles from the city of Los Angeles, the fire proof, multiple-compartment garage, is located. The building is 30 feet wide and 340 feet in length and in it is housed the fleet of 23 delivery trucks which the company operates, the smaller company cars, and cars of the employees. Here also is located the repair shop for automobiles and the usual busy paint shop that is common to all refineries operating in the Southern California district. In the paint shop the company refreshes and repairs its hundreds of road signs, its cars, trucks and small advertising boards. In the score or more of refining plants that the writer has visited in the Los Angeles basin territory, it has always been noted that one of the busiest departments of the refining plant is always the paint shop—for road signs are essential and they must be bright, clean and fresh.

Built for Growth

Behind the garage is the large two-story lube oil warehouse and office—of brick and steel—fire proof. The power plant building; housing three horizontal return tubular boilers of 100 horse power each, which supply steam through insulated lines to all departments of the plant. A No. 3 Jewel steam engine driving a Western generator supplies lights for the entire plant. A full set of fuel and water feed pumps, in duplicate—and an air compressor, comprise the power house equipment.

The main pump house, constructed of brick and concrete, high, airy, well lighted, also gives room for a spacious, modern and well equipped laboratory. The pumping and transfering work here is performed by eight Burnham pumps, size 8½x5x10 inches. Sufficient room is provided in this building for the installation of as many more pumps as are at present employed. This is in line with the general lay out of the entire plant. It is so arranged that at any time, the size and capacity of any department can be enlarged or doubled without disturbing or hindering the operation of the present installation.

The still settings and still installation, as shown in Figure 1, is massive in its construction; stills set high to insure a large commodious furnace, and the entire battery of five stills are firmly tied together at the top by a series of heavy steel beams extending at intervals of a few feet across the tops of the stills. This steel bracing supports the 10 inch vapors lines, and the three inch back trap lines above the stills proper.

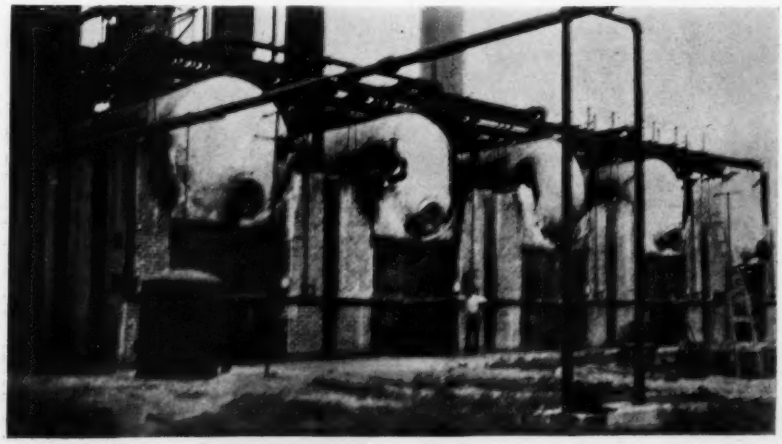
It is noted, that, though the stills are set high, and resting directly upon the brickwork that the brick construction of the setting is unusually free from cracks and breaks. The heavy foundation, of course, is partly responsible for the preservation of the still setting.

Pipes Accessible

The supporting walls of the condenser boxes, and also the towers which are supported by a framework above the boxes, form also, a pump house for still operation purposes, and a warehouse room of large dimensions, as well as a change house for the employees.

The receiving house, which is likewise constructed of concrete and brick, is so designed that each line entering and leaving the inspection room is easily accessible for repairs or changes. The lines enter the side wall of the receiving house in the usual manner and extend to the look box—then, as usual, to the manifold header, and here an improving idea is noted. The many run down lines of the manifold extend downward through specially provided circular holes in the concrete flooring into the room below the receiving house. The lines extend far enough into this lower room, that men can work handily with the fittings. Each line as it drops from the manifold header above is cornered abruptly in a Tee—no ells are used—the oil flows then to the tank through underground run down lines. The plugged Tee makes for ease of cleaning and inspection. This manifold, is therefore easily accessible and changes can be made easily without the workman having to enter the receiving house to do so. The water traps provided on each run down line also extend down into this room, where provision is made for cleaning the rust and sediment from them, at an easy height from the floor. One side of this large room is also available as a tool room or warehouse. Every detail is also provided in the receiving house to care for future expansion and enlargement.

Another interesting detail of construction is noted in the installation of



Distillation equipment, showing construction of stills, setting and steel beams bracing across top of stills.

Area between rear of stills and pump houses. Lines above ground for accessability

the flue gas channel conducting the spent gases to the smoke stack. This cylindrical brick flue, five feet in diameter, is about one half above ground at its starting, just back of the first still, and gradually rises out of the earth, until it is all completely above ground at the back of the last still, then angling off to the base of the stack—which is set high upon a concrete setting. This type of installation has certain advantages in that the flue gas channel is constantly before the eyes for inspection and any inclination to burn out, break or fall in is certain to be noted immediately. In addition, it also acts as a protective fire wall between the stills and pump house.

Distillation

The distillation equipment consists of five 440-barrel shell stills. Three of these stills operate continuously, being charged with crude, all three stills being utilized for the removal of gasoline and charged at the rate of approximately 4000 barrels of crude oil daily. Three streams of finished gasoline are thus received in the "tail" house and conducted to run down. The dephlegmators are of the peculiar type known as a tower within a tower. The vapors being conducted first through the outer shell, then into the inner towers from where they emerge through numerous small opening into the top void; and then to vapor line and condenser. The back trap or reflux accumulating inside of the two compartments of the tower is returned to the retort of origination, except that reflux of the third tower in the series. The condensate here is conducted to either the fourth or fifth still, where it is re-run. The third tower of the series is a Southwestern bubble tower equipped with a Southwestern control condenser or knock-out box, through which the incoming or charging crude is circulated. The rate of flow, and hence the temperature of the tower and vapors is automatically controlled by a Foxboro Automatic temperature controller. This equipment makes it possible to cut deeper into the crude in the third still in the continuous system and provides for a closer cut of gasoline and a heavier reflux condensate from the dephlegmator. The reflux condensate is the source, upon redistillation in the 4th and 5th shell stills of certain special distillates or naphthas, and of a rerun, steam distilled kerosene. The still bottoms from these two stills are utilized as gas oil or heavier distillates.

Improvements Planned

The crude petroleum leaving the control section of the dephlegmator, as previously mentioned, is conducted to two shell type heat interchangers, where it flows counter current to the hot residuum leaving the last still of the continuous system, and after passing through the exchange apparatus enters the first shell still at a temperature of about 275 degrees F.

The company is distilling crude oil from the Santa Fe Springs field which yields, as a rule, approximately 30 to 32 per cent gasoline. The plant operation yields correlate very closely with laboratory distillation records.

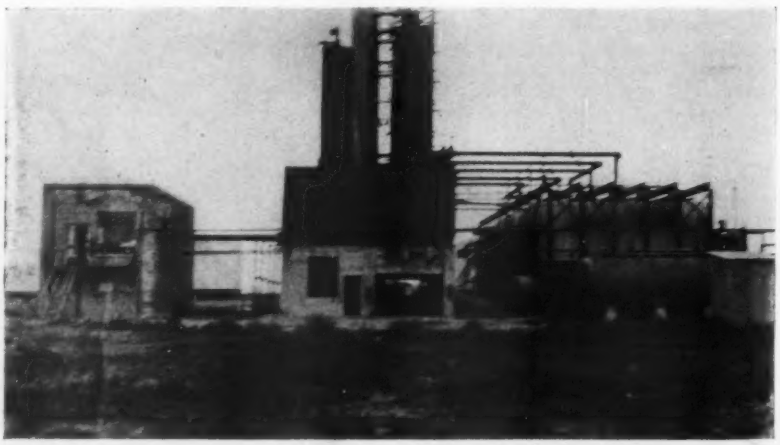
W. F. Pyne, manager of the company, refining operations, which includes plants at El Paso, Phoenix, and Nogales, as well as the Vivale property, states that primary among the tentative improvements at this plant, is the early conversion of the four dephlegmators into rectifying towers of the bubbling type, which in all likelihood will be of company design. It is planned that up completion of this work that the plant will be enlarged in capacity by the installation of a cracking unit.

Isometric Map of Lines

Among the items of importance which are often found lacking in refining organizations is a complete and detailed record of lines laid for transfering products about the plant yards. It is often necessary to search minutely with pick and shovel over a refinery yard for the exact location of a certain line, or a certain buried gate, tee, or connection. Too often, this type of information or knowledge is carried solely in the mind of some employee—pumper, stillman or yard foreman, and throughout the years when superintendents change, the plant yards may be cluttered sometimes with miles of valuable pipe lines, the purpose and location of which is often forgotten.

To offset this disadvantage and to assure constant knowledge of the location, position and purpose of every foot of pipe within the plant yard the company has had prepared an Isometric Map of all carrier lines that are present in their 100 acre tract of property. This map is complete in every detail. First the location and direction of extension of all lines is given, showing the size of line, as 1, 2, 3, 4, or 6-inch. This gives the information as to direction of flow of all materials. Further, the class of line is given, whether for fuel oil, crude, gasoline, distillates, and designates as to purpose—steam, water, air, sewer, run down lines and so forth, Almost at a glance a novice can tell for what purpose each or any line is employed. In addition, a separate drawing shows the manifolds in detail, how arranged and for what purpose each pump is operating. Then the valuable

(Continued on page 78.)



Space between condenser boxes and receiving house is utilized

Types of Buildings For Housing Refinery Equipment

By H. L. Kauffman

Associate-Member A. S. M. E., Denver, Colorado

THE problem of determining the most suitable and economical type of building for housing some particular refinery equipment, or for providing necessary working facilities for some department of the plant, is one that is encountered at some time or another by every refinery executive. This may come about in deciding on plans for an entire new refinery; or in planning additional refinery manufacturing facilities; or, merely, as a result of the necessity of replacing some building that may have been destroyed by fire, or because an old building has already served its full period of useful life and, therefore, a new one is required.

In the present article the writer will make mention of the kinds of material that are appropriate for the buildings that house the different types of refinery equipment. Since it is a well-known fact that each particular kind of building material is, for one reason or another, especially adapted for one or more particular uses, an effort will be made to show herein the uses of the several different types of building materials in refinery construction. Reasons for the use of a particular building material, in specific instances, also will be given; for, as we know, brick has its uses, concrete and metal buildings have their place, while, in a few instances, the use of wood is preferable over any other kind of building material.

Classification of Buildings

Refinery buildings may be classified most conveniently by noting whether they should be fireproof or non-fireproof, or whether merely having them fire-resistant from the exterior will prove suitable. Since the best way to insure a plant of adequate *fire protection* is to provide for *fire prevention*, this latter can be practiced at no time to better advantage than when designing either the entire refinery or a particular building of the plant.

For purposes of comparison, Bell ["American Petroleum Refining," Chapter 23, pps. 428, 429 (D. Van Nostrand Co. 1923)] gives the following useful classification of buildings, and then briefly describes the building materials that are to be preferred for each of the three classes:

Class A.—Fireproof.

1. Pump houses.
2. Filter plants.
3. Wax plants.
4. Laboratories.
5. Filling houses.

"Buildings of this class should be reinforced concrete frame with tile or brick curtain walls. Steel sash with wire glass and metal-covered doors should be used. Buildings with steel frames and trusses are acceptable, if all steel work is properly protected. It must be realized that exposed roof trusses, for instance, will fail quickly if subjected to a hot oil fire underneath. When steel trusses are used, cement tile or thin concrete slab roofs are recommended."

Class B.—Fire-resistant from exterior.

1. Power houses.
2. Shops.
3. Still sheds.
4. Barrel factories.
5. Can factories.
6. Warehouses.

"Buildings included in this class are those in which the risks from inside fires are slight, but which are desired to be practically fireproof from the outside exposure. Exposed steel work is allowable under these conditions, and the choice is a matter of cost only, being reinforced concrete, and brick-and-steel. Steel sash, metal-covered doors and fireproof roof coverings are essential."

Class C.—Non-fireproof.

1. Temporary buildings.
2. Buildings not exposed to or offering risk from or to other structures.

"This class covers frame buildings or those with brick walls and wood roofs. Doors and windows are of ordinary wood type."

Before discussing what any particular company has adopted as the type of building construction most suitable for their particular needs, it may be advisable to mention what other refinery engineers have to say concerning the type of building construction for various refinery departments.

On this subject Nugey ["Oil Refinery Specifications," pages 111, 112. The Chemical Publishing Company (192)] makes the following statements:

"The receiving house, filter and clay burner house, transfer and loading pump house, wax plant, compounding and barrelling plant and boiler house are all to be of masonry or reinforced concrete and steel construction throughout. All exposed steel work is to be fireproofed with either concrete, terra cotta or gypsum blocks. All floors and roofs are to be of non-combustible construction. Only metal roof frames, sashes, doors and wire-inserted glass should be used.

"The power house, machine shops, carpenter shop, locker and lunch room, pipe shop, car repair shop, steel fabricating shop, electrical shop, barrel and can-manufacturing plant, storage sheds and office building—all are to be of masonry or reinforced concrete construction. The exposed steel work need not be fireproofed. Roof is to be of non-combustible construction. Floors and other interior work may be wholly or partly constructed of wood. Metal window frames, sashes, doors, wire-inserted glass or polished plain glass may be used, depending upon local conditions and fire zone.

"The temporary buildings or buildings not exposed to fire hazards may be of frame construction throughout with walls, partitions and roof of wood or corrugated iron."

Parenthetically, Nugey's comments concerning the steps of procedure in designing a building are of interest, since there is given in brief, outline form facts known to every engineer.

"In making a design for a building the span of the roof is generally given, also certain limits regarding its height and style.

"The following then are the steps of procedure:

1. Design the roof covering and find its weight.
2. Make skeleton outline of the proposed truss.
3. Assume proper snow and wind loads.
4. Compute maximum stresses in all members.
5. Assume proper working unit stresses for the materials.
6. Design the sections of the connections.
7. Make drawings, compute weights and estimate cost."

A. D. Smith [Day's "Handbook of the Petroleum Industry" Vol. 2, pps. 228-32. John Wiley & Sons, Inc. (1922)] mentions the following buildings and shops as being essential features of a complete refinery, and then goes on to state what he considers to be a suitable type of building construction for housing each department or unit.

Smith states that in building a new refinery the buildings and shops mentioned should be constructed in the following order:

1. Supply storehouse.
2. Carpenter, pipe and machine shop.
3. Boiler and power houses.
4. Pump houses.
5. Receiving houses.
6. Laboratory.
7. Office.
8. Wax plant.
9. Filter plant.
10. Shipping and cooperage buildings.
11. Car-repair shop.

". . . . .A good substantial storehouse should be one of the first buildings erected and should be closely followed by the pipe and machine shop. The standard factory buildings offered to the trade are admirably adapted to these purposes. Such buildings may be bought in steel frame construction, for immediate shipment from stock, in variable widths of 30, 36, 40, 50 and 60 feet and in multiple lengths of 20 feet—thus meeting almost any requirement. Windows and doors may be

Research Laboratory

arranged to suit, the frames being covered with asbestos-protected metal, galvanized steel or black iron as may be desired. Even brick walls can be installed where it is deemed necessary. Asbestos-protected metal is recommended for the buildings under consideration . . . . The size of the storehouse building and of the buildings for the carpenter, pipe and machine shops, obviously, will depend on the capacity of the plant, the nearness to supplies, the completeness of machine-shop equipment, etc. For example, a certain 5000-barrel plant, which includes refining to lubricants, and which is two days traveling distance away from supplies, finds a storehouse 30 x 60 feet and a machine shop 50 x 60 feet adequate to its needs. The latter, in fact, is of sufficient size to allow the partitioning of one end into a black-smith shop and a carpenter shop. In larger plants, these latter-mentioned shops would be more efficient as detached units.

". . . . . .In the case of the boiler and power houses here again the standard ready-made building can be used to advantage. In determining the size of the building, some consideration should be given to climatic conditions, for a congested, ill-ventilated boiler house in the warmer latitudes (especially in large plants) means poor operating efficiency. In general, it is advisable to delay the erection of the building proper until the boilers themselves have been hung in supporting frames.

"On account of the inflammable nature of the products handled, and the proximity of the receiving houses to the stills, both the pump houses and the units last named, preferably, should be of brick construction, with concrete roofs, doorways and windows, fitted with metal-sheathed, self-enclosing doors and shutters and provided with fusible links to release in case of fire. In other words, fire-proof construction should be used throughout. The size of such buildings, of course, will depend on the number and type of the pumps installed in the one case, and the number of entering run-down lines in the other. In the pump-house design, sufficient room should always be left to allow the withdrawal of the pump pistons. It should further be noted that distributing manifolds will often require proportionately more room than the pumps themselves. A safe procedure for determining the length of the receiving houses is to space run-down manifolds on 3′ 6″ centers, with equal intervals at the ends of the building. The width of the latter should be governed by the number of proposed run-down lines, it being always advisable to make allowance for future additions . . . .

". . . . . Next should be started the refinery laboratory and office buildings. . . . . The size of these buildings depends upon the capacity of the refinery and the amount of laboratory and office work to be done. However, both should be of fireproof construction throughout.

" . . . . . Wax plant and filter-house buildings, obviously of special design, should be of heavy, substantial construction, and the laying of the walls should be retarded until the heavier equipment is installed . . . . The 'oven' walls of a wax-sweater building usually are specially constructed with a central course of insulating brick . . . .

"Shipping and cooperage buildings may be adapted from previously mentioned standard buildings, but if they are to be more than one story high, special design is advisable. Fireproof construction, of course, should be used throughout; the size, naturally, will depend upon the amount of compounding, whether shipping is done by barrels or cans, and whether the latter are manufactured or prepared at the plant. . . . . .

"The erection of a car-repair shop may be left until the last, unless it is also to be used as a boiler shop. This combination, which is advantageous in certain instances, necessitates the early completion of the shop, if the fabrication of any plate work is to be attempted by the refinery during the general building of the plant. Here again, the standard building, complete with traveling crane, can be used very profitably. Several well-known plants have adopted this plan."

Types of Building Construction

In general, it may be said that there are two main types of construction, *wooden frame* and *steel frame*, which broad classifications may be further sub-divided as follows:

Wooden Frames

1. With wooden walls and roof.
2. With wooden walls and metal roof.
3. With metal walls and metal roof.
4. With masonry walls and metal roof.

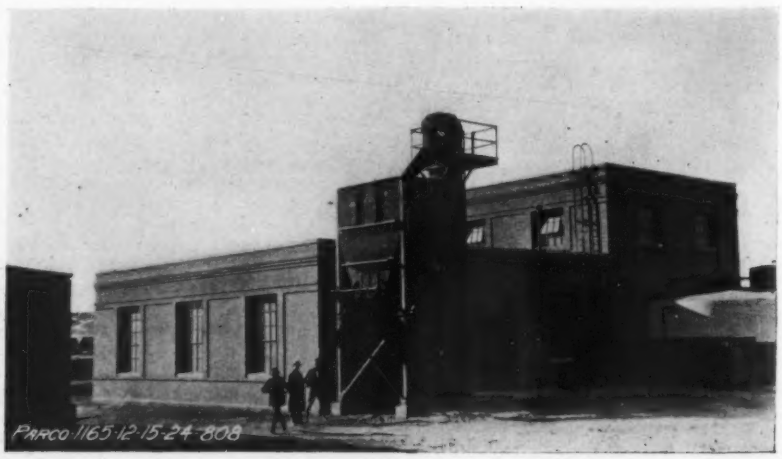
Steel Frames

5. With wooden walls and metal roof.
6. With masonry walls and metal roof.
7. With concrete walls and metal roof.

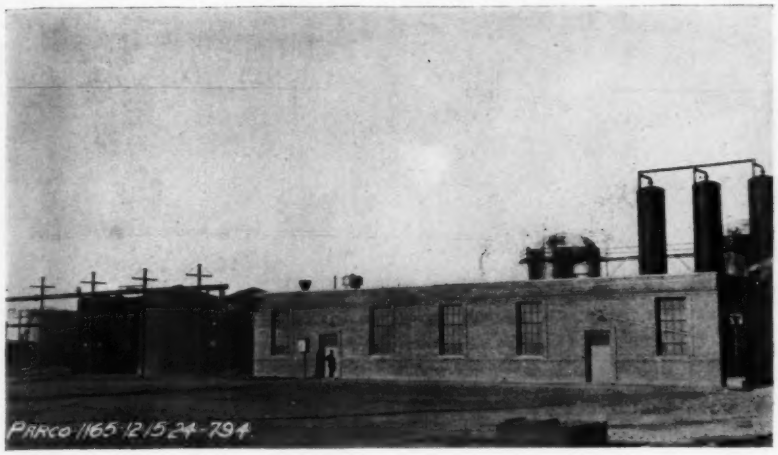
In either one or another of the above classes can be placed, with few exceptions, almost every kind of building in use in petroleum refineries.

Buildings of type (1) are usually temporary buildings, or merely buildings for providing rough shelter for equipment of lesser importance. This is also true of buildings of type (2), although such buildings are constructed more often in the warmer climates where the usual objections to metal roofs do not prevail.

Steel frame buildings with metal walls and metal roofs are increasing in popularity in refinery construction (less frequently wooden frame buildings with metal walls and metal roofs) chiefly because they are fire-resisting, of low cost, and can be quickly constructed. Cor-



Contact Filtering Plant



Light Oil Treating Plant

rugated iron buildings are used for housing natural gasoline plant equipment; machine and pipe shops and blacksmith shops; carpenter shops; boiler house and car-repair shops; certain parts of continuous light oil treating plant equipment; some parts of certain pressure still equipment; sometimes, for laboratory buildings, as when keeping construction costs to a minimum is necessary; and for a number of other miscellaneous purposes.

Wooden frame buildings with masonry walls and metal roof represent a compromise between the hazardous and the fireproof types, and hence they are often termed "slow-burning" construction. Buildings of this class have much to recommend them—the chief of which is economy of construction—but they should not be used for any refinery buildings over two stories in height; and should be used only when a one-story building that is fire-resistant from the exterior is to be constructed.

Steel frame buildings with wooden walls and metal roof represent a type of construction that has much to recommend it for single-story work. The steel frame gives fire protection and, where required, supporting strength for cranes (such as are used often in a car-repair shop.)

Buildings with steel frames and metal roofs and with either masonry or concrete walls are the most suitable types of buildings for refinery purposes, and, as a result, they are found in extensive use in nearly all refineries where a permanent building of long life is desired. Such buildings are fireproof and are the ideal structures for long time investments and for housing refinery manufacturing equipment where a building of more than one-story elevation is required.

Building Materials Used in Housing Refinery Equipment

A. D. Smith [Day's "Handbook of the Petroleum Industry", Vol. 2, pps. 248-259, John Wiley & Sons, Inc. (1922)] has the following to say (quoted in part only) concerning the building materials that are used in housing refinery equipment:

Brickwork

"A moderately hard-burned brick should be selected for refinery construction. A very hard brick cuts with difficulty, and a soft brick does not stand up under service conditions. Bricks containing quicklime (appearing as small white spots) should be rejected, since such brick will crack or disintegrate under the action of water. With dimensions varying from 7¾ inches to 8¼ inches in length, 4 inches to 4½ inches in width, and 2 inches to 2¼ inches in thickness, exact formulas for general computation are only possible where the size of the brick is definitely known. . . .

" . . . . . For laying 1000 bricks in wall construction, 1¼ barrels of lime, ⅜ cubic yard of sand, and 1 sack of cement should be allowed . . . "

Stonework

"Stonework is rarely used in refinery construction today, although, occasionally, wax-plant press vaults are built from the same, and sometimes ornamental office buildings. Wall measurement is by the perch (24¾ cubic feet), openings over 3 feet are deducted, with 1½ feet added to running measure for each jamb built, and arches solid from the spring. Corners of walls are measured twice; pillars less than 3 feet are measured 3 sides as linear length, obtaining the cubic contents by multiplying by fourth side times the depth; all foundations are measured by cubic feet. For laying 1000 feet of stone, 1¼ barrels of lime, 1 cubic yard of sand, and 1 sack of cement are required . . ."

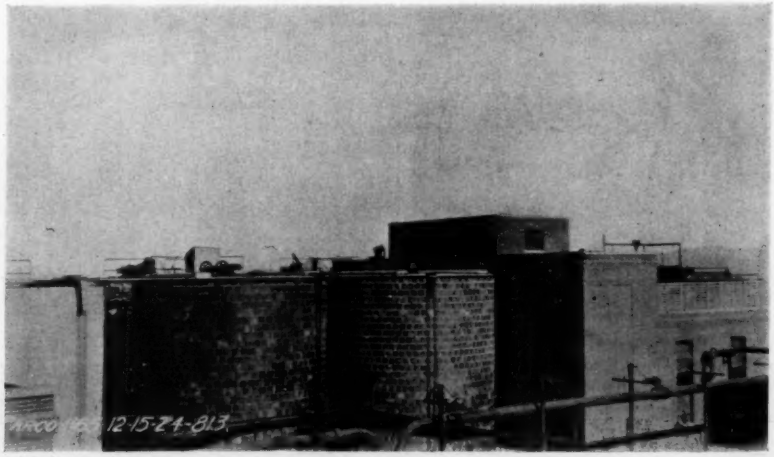
Concrete

"On account of occasional long storage, exposure to dampness, etc., cement should be carefully tested as received, during all periods of construction, not only by standard laboratory methods, but by frequent inspection of small batches taken from the mixers themselves under service conditions. The cement obtainable today is so generally uniform that failures in concrete construction, rather than being caused by an inferiority in cement, are more likely to be the result of one or more of the following causes:

1. Use of concrete of improper consistency; too little or too much water.
2. Insufficient cement in mixtures for stresses developed.
3. Insufficient mixing of concrete.
4. The use of unsuitable aggregates; either not properly graded, or containing clay, loam, etc.
5. The use of dirty water, or of water containing injurious chemicals.
6. Failure to keep concrete from drying out after placing; i. e. preventing it from hardening under the proper protection.
7. Premature removal, or use of dirty, or improperly braced forms.
8. Non-prevention of freezing before setting.
9. Engineering computations not in accordance with established principles of mechanics and accepted good practice.
10. Failure of reinforcement material to conform to standard specifications.
11. Failure to obtain good bond between fills.

"Concrete is now widely used in refinery construction, particularly in locations adjacent to heated surfaces, such as still

(Continued on page 68.)



Sharples Plant

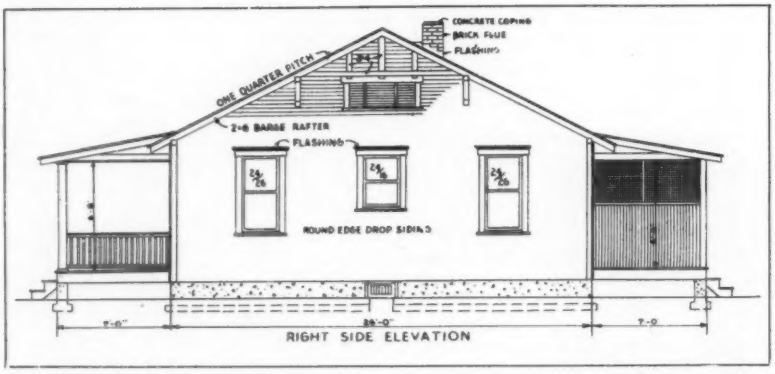
Homes of Phillips employes at the Burbank natural gasoline plant

Good Houses Get Good Care

GIVE a man a good house and he will take care of it. That is a brief statement of how the Phillips Petroleum Company takes care of its housing problem. Only it is not a problem with this company, just a simple matter of building good strong modern homes and then allowing workmen at the natural gasoline plants to live in them at a nominal rent.

The whole thing is free of rules and restrictions. A man is supposed to make any repairs resulting from his own carelessness or that of his family. For instance a broken window pane is replaced by the man in the house.

Painting, papering and items that come under ordinary depreciation are matters for the company to correct. But the company has no system of keeping check on papering or painting. Neither does it have any inspection of houses. When a man moves out of a house he is supposed to leave it in as good condition as when he moved in, except for normal depreciation.



Appreciation

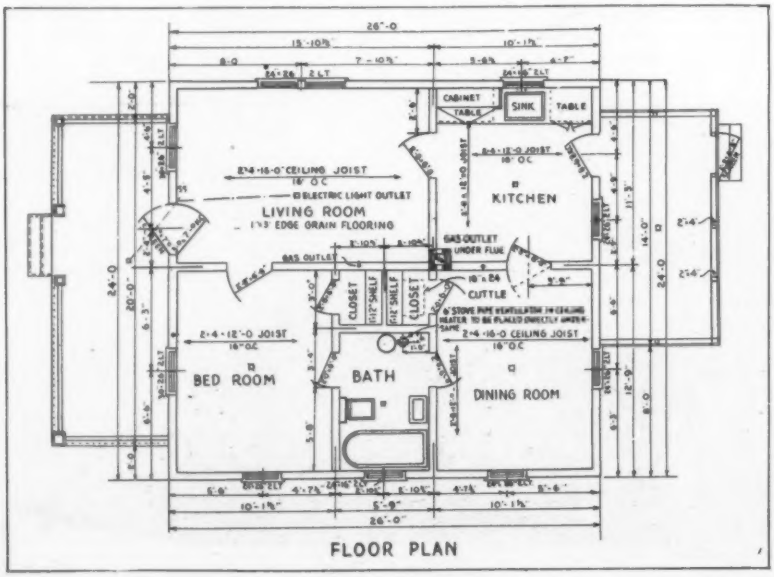
Perhaps somewhere in the plan someone conceived the idea that a man would appreciate having a house built by the company and turned over to the man and his family to keep as their own home. Anyway that is how the Phillips Company goes about housing its hundreds of employes and their families at the natural gasoline plants of the Mid-Continent area.

Providing houses for natural gasoline plant workmen and their families is combined with the provision of quarters for men of the oil producing department of the Phillips Company. Whatever is said of one includes the other.

When a natural gasoline plant is built, the effort is made to have single men put on the construction job to as large extent as possible. These men are cared for in "bunk houses," thus relieving the company of building individual homes until it can be determined how many will be needed. This is the foremost method of preventing the overbuilding of homes.

And there is a reason for seeking to escape the provision of more houses

(Continued on page 72.)



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Methods of Determining the Specific Gravity of Natural Gas

By Guy S. Mitchell

Specific gravity is a quality universally sought when consideration is given this product.

The specific gravity bears such a relation to other qualities that it may be termed a universal indicator of the content of the gas.

For these reasons, methods of determining the specific gravity of gas are a sort of pass key into the study of natural gas. The author of the accompanying paper has devoted time and experiments to collecting the data presented. The articles will run in the next two or three issues of The Refiner and Natural Gasoline Manufacturer.

—The Editor.

IN all fields of the gas industry, we find that specific gravity is one of the most common tests made on the gas. Though this property does not always vary with a variation in the constituents of the gas, a variation of the specific gravity will usually mean a variation in the per cent of the constituents and a quick and accurate method of obtaining specific gravity is very serviceable in the gas industry at times. Perhaps the most important use of the gravity of gas is in the measurement of gas volumes by means of the orifice and flow meters. In measuring the volume of gas by means of the Orifice Meter for instance, the formulas are calculated for a certain specific gravity 0.6 or 1.0 and for any variation in gravity a correction must be made. An error of one to two per cent in the determination of the gravity of the gas, which is not at all uncommon in ordinary practice, will result in an error of 0.5 to 1.0 per cent in the corrected volume of gas measured. One can readily see that under such conditions the errors will soon amount to large sums in the transfer of large volumes of gas. Gasoline content is also sometimes estimated from the specific gravity though this is a somewhat inaccurate method.

It can readily be seen from this brief review that specific gravity is quite often of great importance in the gas industry. It is evident, however, that any method of determination should combine ease of manipulation with rapidity and accuracy. The different methods commonly used vary considerably in accuracy and the importance of the test and accuracy desired will therefore govern the method that will therefore govern the method that should be used. The effusion method because of its rapidity and ease of manipulation, is the one most commonly used in the gas industry. There are many sources of error in the method, but its accuracy is surprising when due precautions are taken. It is the purpose of this article to give a comparison of the different methods of determining specific gravity of gas, giving their merits and demerits, and also to enumerate the errors of the effusion method and explain how they may be corrected. Though under certain conditions the method is quite inaccurate,

Different Methods Employed

There are four principal methods by which the specific gravity of gas may be determined: the effusion method; gas density balance method; direct weighing method; and calculation from the analysis.

The effusion method was first used by Bunsen and the different types are in reality only modifications of his method. The principal modifications or types are the Butterfield, Schilling, Jenkins, and the Bureau of Standards and of these different types the last named is the most accurate.

The gas density balance was perhaps first used in gas works in the form of the Lux balance. The natural gas industry has now taken up this type of apparatus. The type most commonly used being the Edwards balance, while the Pierce and other types are gradually coming into use. A very unique type of density balance is one devised by Aston in his work on Neon with which he determines the density of as small a quantity of gas as one cubic centimeter obtaining an accuracy of 1 per cent.

The most standard method of determining density of gases is the direct weighing method. This was possibly first described and used by Regnault, Bunsen, and Letheby.

The gravity of gases may also be obtained by calculation from the chemical analysis. The accuracy of the method depends entirely upon the accuracy of the analysis and since considerable skill and technique are required for analyzing gases this method of obtaining specific gravity is not recommended unless the analysis is made by an experienced analyst.

Apparent and True Specific Gravity

The term "apparent" specific gravity as used in the work has reference to the specific gravity of a gas saturated with water vapor. For example with the effusion method when water is used as the confining liquid both the gas and air are saturated with water vapor and the gravity thus obtained is the "apparent" specific gravity. The "true" specific gravity is that obtained when both the gas and air used are in the dry state.

Comparison of Methods

A comparison of results obtained by the four principal methods outlined above are given below. These determinations were carefully made and show what can be obtained when due precaution is taken and when conditions are as near ideal as possible.

The effusion method as used needs little explanation here since the method is quite commonly used and is also taken up in detail later in the work. Water was used as the confining liquid so that a correction was therefore made for water vapor. It will be seen that when applying this correction the method checks well with the standard methods.

In the gas density balance method a laboratory type of Edwards gas density balance was used. Detailed description of the apparatus and method of using can be found in Technologic Paper No. 89 of the Bureau of Standards. In making a determination the gas and air both are previously dried by passing through calcium chloride and phosphorous pentachloride tubes. The apparatus is first purged with air, a sample of air is then drawn in the balance, the pointer adjusted to the desired position, and the manometer reading is then taken and from this the absolute pressure is determined. The formula used for calculating the specific gravity is as follows:

$$\frac{S_g}{S_a} = \frac{P_1}{P_2}$$

S_g is the specific gravity of gas, S_a the specific gravity of air, P_1 the pressure at which the beam balances in air, and P_2 the pressure at which the beam balances in the gas. The specific gravity of air is taken as 1 and the formula becomes:

$$S_g = \frac{P_1}{P_2}$$

The method is accepted as a standard method and with it an accuracy of .1 to .3 per cent is obtainable. A typical determination is shown in the following table.

Barometric pressure (millimeters)		729.3
Manometer readings with air (millimeters)	242.5 117.0	
Pressure (millimeters)		—125.5
Total Pressure		603.8
Manometer Readings with Gas millimeters)	338.5 12.7	
Pressure (millimeters)		325.8
Total Pressure (millimeters)		1055.1
Specific Gravity	603.8 1055.1	.5723

The direct weighing method is the most standard way of determining gas density but, unlike the previous methods, it requires more technique and precautions.

The procedure for determinations by this method was to carefully weigh both gas and air in the standard gas density flasks. The gases were of course previously dried and the temperatures were regulated by means of a constant temperature bath. When a suitable chemical balance and other chemical apparatus is at hand this method affords a reliable and accurate method of determining specific gravity.

The accuracy of the method of calculation from the analysis is dependent entirely upon the accuracy of the analysis. The accuracy of the analysis depends largely upon the technique of the analyst in manipulation of the apparatus and partly upon the type of apparatus used. For the analysis of the gases in the work the slow combustion method was used. The type of apparatus was identical with that used by Allen and Lyder in their work on the natural gases of Kansas and Oklahoma[1]. The calculation of specific gravity from the explosion method of analysis invariably gives lower results than the slow combustion method. This is due to the formation of oxides of nitrogen in the explosion analysis which gives the percentage of methane high and the percentage of ethane low. The explosion is therefore not recommended for accurate work. For the most accurate analysis of hydrocarbons in gas the method of fractional distillation must be used. With gases such as the Lawrence City gas, however, which contains only a very small percentage of heavy hydrocarbons, and chiefly methane and ethane, a calculation of specific gravity from the combustion analysis introduces only a slight error. The specific gravity is calculated from the known specific gravity of the constituents that comprise the gas. In the analysis of natural gas the residue is calculated as nitrogen. With gases such as that used, the residue is practically all nitrogen but with some high residue gases, such as are found near Dexter, Kansas, which contain 40 to 98 percent residue, a small percentage of helium[2] or other inert gas may be present with the nitrogen and in such case a slight error will be introduced unless the per cent of such constituent is known.

The table below gives a comparison of the results obtained by the different methods which have been outlined for determining gravity. Results are shown which were obtained on two different samples of gas.

Method—	Specific Gravity of Lawrence Gas 1	2
Effusion	.580	.579
Effusion (corrected for water vapor)	.5716	.571
Edwards Gas Density Balance	.5723	.570
Direct Weighing	.5723	.570
Calculation from Analysis	.5725	.575

The Effusion Method

This method is widely used in commercial practice because of its simplicity, ease of operation, and the rapidity with which a determination can be made. As generally used, however, the time for effusion is taken on the gas and air saturated with water vapor which introduces a certain amount of error, varying with the temperature of the experiment and the true gravity of the gas. In the work that is to follow, the method was investigated as to the source of errors and the accuracy that can be obtained by varying the conditions of the experiment.

Before giving the experimental data and other work on the effusion method, a derivation of the formula used for calculating the specific gravity of a gas from the data obtained in an experiment will be given. As stated previously, the method was first used by Bunson in his work on gases and is based upon the fact that the specific gravities of two gases escaping through an orifice or narrow opening in a thin plate have nearly the same ratio to each other as the square of their speeds of escape. This may be expressed by the formula:

$$\frac{S_1}{S_2} = \frac{T^2_1}{T^2_2}$$

where gas S_1 has a speed of escape T_1 and gas S_2 has a speed of escape T_2. Air is usually run as S_2 and regarded as 1 so that the equation becomes

$$S_1 = \frac{T^2_1}{T^2_2}.$$

The apparatus is shown diagrammatically in figure 1. The jar A is the effusion jar and is filled with aid to a certain level b. Tube B is the effusion tube and c the platinum orifice. The time for effusion is taken for that volume of gas in the tube represented by the distance between the marks c and g on the effusion tube. This volume is represented by v which is the volume of gas effused. The water head at the start is represented by the difference between water level i and water level c of the effusion tube while the water head at the finish is represented by the difference between the water levels g and h.

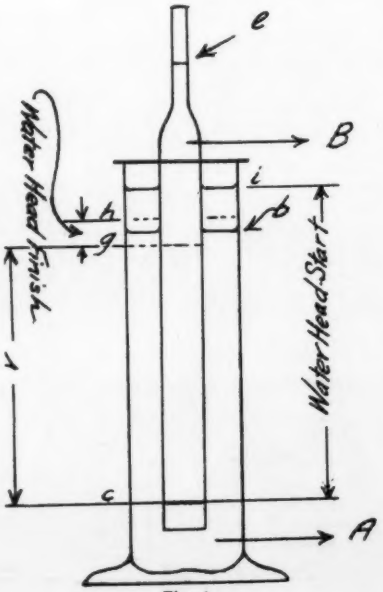

Fig. 1.

The work done by the water on the gas and air during effusion is the same in each case so that the formula for the specific gravity of the gas may be derived from the old established physics equation for work which states that "work" equals "mass" times the square of the "velocity." "M" represents the mass of the gas or air effused as the case may be and "V" represents the velocity of the effusing gas or air. Letting t equal time, d equal density, and S equal specific gravity (the subnumeral one in each case refers to gas and the subnumeral two refers to air) the derivation may be given as follows:

$$\text{Work} = M V^2$$
$$M_1 V^2_1 = M_2 V^2_2$$
$$\frac{M_1}{M_2} = \frac{V^2_2}{V^2_1}$$

and since the velocity is inversely proportional to the time.

$$\frac{M_1}{M_2} = \frac{T^2_1}{T^2_2} \qquad d = \frac{\text{Mass}}{\text{volume}}$$

and letting the volume equal unity, the equation becomes

$$\frac{d_1}{d_2} = \frac{t^2_1}{t^2_2}$$

S is proportional to d therefore

$$\frac{S_1}{S_2} = \frac{t^2_1}{t^2_2} \qquad S = \text{air} = 1$$

$$\text{and } S_1 = \frac{t^2_1}{t^2_2}$$

Temperature and pressure must remain constant throughout the experiment or some error will be introduced due to this source. When water is used for the confining liquid, both the gas and air are saturated with water vapor so that, unless a correction is made, the apparent specific gravity may, under certain conditions, vary considerably from the true gravity. Such a correction is made as shown in a following paragraph on the effect of water vapor.

Gases Used in the Work

There were three gases used in the work (1) the Lawrence City Natural gas; (2) Linde Oxygen, and (3) electrolytic hydrogen. The samples showed the following analysis:

	Lawrence City Natural Gas	Oxygen	Hydrogen
Carbon dioxide	0.67		
Oxygen	0.00	99.0	.35
Methane	96.69		
Ethane	1.00		
Hydrogen			98.48
Residue (Nitrogen)	1.64	1.0	1.17
Specific Gravity (Calc. from anal.)		1.103	.0836
Specific Gravity (Edwards Balance)	.572		

Later in the work the Lawrence gas became slightly heavier and showed a gravity of .574 on the balance. The hy-

[1]Engineering Bulletin No. 11, Univ. of Kans.
[2]Cady and McFarland, Geological Survey of Kansas, 9, 228 (1908.)

TABLE I

APPARENT SP. GR.	SPECIFIC GRAVITY - CORRECTED FOR WATER VAPOR					
	15° C.	% Error	20° C.	% Error	25° C.	% Error
.1000	.0901	9.00	.0865	13.50	.0820	18.00
.2000	.1912	4.40	.1880	6.00	.1840	8.00
.3000	.2923	2.57	.2895	3.50	.2860	4.67
.4000	.3934	1.65	.3910	2.25	.3880	3.00
.5000	.4945	1.10	.4925	1.50	.4900	2.00
.6000	.5956	.73	.5940	1.00	.5920	1.33
.7000	.6967	.47	.6955	.64	.6940	.86
.8000	.7978	.28	.7970	.38	.7960	.50
.9000	.8989	.12	.8985	.17	.8980	.22
1.0000	1.0000	.00	1.0000	.00	1.0000	.00
1.1000	1.1011	-.10	1.1015	-.14	1.1020	-.18
1.2000	1.2022	-.18	1.2030	-.25	1.2040	-.33
1.3000	1.3033	-.25	1.3045	-.35	1.3060	-.46
1.4000	1.4044	-.31	1.4060	-.43	1.4080	-.57
1.5000	1.5055	-.39	1.5075	-.50	1.5100	-.67

drogen became contaminated ofter being made and showed a gravity of .171.

Orifices Used

Various sizes of orifices were made for use in the work and the size and characteristics of a number of them is given in different places throughout the work. Briefly, the method of making them was to pierce the platinum foil with a very fine needle and then grind it with a fine carborundum stone until the orifice was free from burrs. The progress was noted under the microscope and by continued grinding a regular orifice could be made. Platinum foil which was .0008-inch thick gave the best results and was used in making most of the orifices.

Variations and Accuracy

The various factors which introduce error in the effusion method are discussed somewhat in detail. Though at times these errors are considerable the method seems to be the most satisfactory for field work, because of its simplicity, ease of manipulation and the rapidity with which a determination can be made. With proper precaution and manipulation satisfactory results can be obtained.

Though several slightly different types of apparatus were used in the work, the type described below was used for most of the work and proved to give satisfactory results.

The types of apparatus used were made from pipettes and arranged in a cylinder as shown in Figure 2. A leveling bulb attachment was used for filling the apparatus with the desired gas. The method of operating was essentially the same as that commonly used with the effusion apparatus with the possible exception that certain precautions that are given in the conclusions were taken.

Effect of Water Vapor

When water is used in the apparatus as the confining liquid, it is apparent that both the gas and air will be saturated with water vapor. The results obtained will therefore give the gravity of the gas uncorrected for water vapor. The error due to this source will necessarily vary with the true gravity of the gas and the temperature of the experiment.

In using the effusion apparatus with water for the confining liquid the gravity should therefore always be corrected for water vapor. The correction table for water vapor given in Table I was calculated from the equation given on page

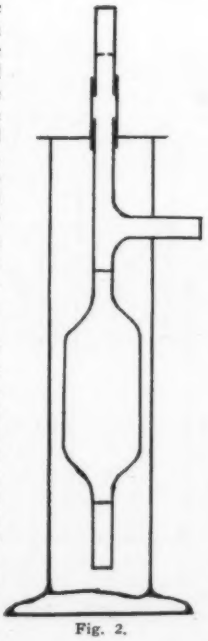

Fig. 2.

below and will show the variation of the apparent gravity from the true gravity. Apparent gravities within the range given but not shown in the table may be obtained by interpolation. This data is given in Figue 3 in the form of a curve.

A derivation of the formula used to correct the specific gravity for water vapor is given in Technologic Paper No. 94 of the Bureau of Standards. The formula is as follows:

$$S_s = \frac{S+k}{1+k}$$

where S_s equals the specific gravity of saturated gas referred to saturated air (or in other words apparent specific gravity, S equals true specific gravity, and k equals a constant

$$\left\{\frac{\text{density of water vapor times}}{\text{density of air}}\right.$$
$$\left.\frac{\text{Partial pressure of water vapor}}{\text{(pressure of gas and air—partial pressure of}}\right\}$$

The variations due to variation in pressure are so small at ordinary pressures that no correction is made for errors due to this source. The values of k for different temperatures are given in the table below so that in making a determination it is only necessary to record the temperature of the water in the apparatus with the effusion data and then substitute the value for k given in the table and the apparent specific gravity (calculated from the effusion data) in the formula above to obtain the true gravity. To illustrate the use of the table:— If the apparent gravity of a gas as found from the effusion data is .700 at 25° C. then the true gravity will be:

$$.700 = \frac{S \text{ plus } .02}{1 \text{ plus } .02} \text{ or } S = .694$$

Values for k at 760 mm. and various temperatures:

$$k\frac{dwpw}{da(p-pw)}$$

Temperature °C	k
0	.004
5	.005
10	.008
15	.011
20	.015
25	.020
30	.027
40	.048
50	.086
60	.151

To show the error introduced due to water vapor, experimental results were obtained on the gravity of the Lawrence City gas, oxygen, and hydrogen at different temperatures in which tests the amount of water vapor in the gas varied. The results of the tests are given in the table II.

The percentage error is calculated on the true gravity of the gases, which is 1.103 for Oxygen, .572 for the Lawrence gas and .171 for the hydrogen. It will be noticed that the results for oxygen are

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but slightly in error and vary only to a small extent at the different temperatures. The results given on the natural gas and hydrogen, however, are considerably in error at the higher temperatures. It is evident that at the higher temperatures the amount of water vapor in the saturated gas will be greater. The presence of this water vapor as shown by the table will cause the apparent gravity to be larger than the true gravity for gases below 1 and smaller for gases with a gravity above 1. The per cent error is also shown to increase with an increase of temperature in the case of the natural gas and hydrogen which are much below one while with the oxygen which has a gravity only slightly above one the error is small at all the temperatures. From the date, it can readily be seen that the apparent gravity should always be corrected for the water vapor present and the resulting value reported as the specific gravity of the dry gas. The specific gravities given in table II are given in table III with the true gravities calculated to the gravities of the gases saturated with water vapor at the various temperatures.

The apparent gravities in most of the above cases check at least fairly well with the calculated (S_a) values, an error of about 1.0 to 1.5 per cent being considered a fair check. It must always be remembered however, that when using water for the confining liquid there is likely to be some condensation of water vapor at the orifice opening and considerable error may at times be introduced from this source. Such may be taken as an explanation of the errors in the apparent gravities given for hydrogen. To avoid the error due to water vapor, sulphuric acid and mercury[3] have been used by some workers. Both of these methods, however, have their disadvantages in that they are not always practical. For field work the sulphuric acid requires too much care and is dangerous to handle on account of acid burns. It also is not always available for use. In the use of mercury, a much greater effusion pressure is obtained which considerably reduces the time of effusion. The stop watch method of timing, therefore, becomes quite inaccurate and a more exact method, such as automatic timing with a chronograph, or other apparatus, is required for accurate work. Such a device would, therefore, make the method impractical for field work. This method is taken up more in detail in a later paragraph of the work.

To Be Continued Next Issue

[3]Hempel Gas Analysis, Trans. by L. M. Dennis Pg. 269, Tech. Paper of the Bureau of Standards No. 94.

TABLE - II

TEMPERATURE °C	OXYGEN				LAWRENCE GAS				HYDROGEN			
	Air Time Sec.	O_2 Time Sec	Specific Grav.	% Error	Air Time Sec.	Gas Time Sec	Specific Grav.	% Error	Air Time Sec.	Gas Time Sec.	Specific Grav.	% Error
30	101.6	106.6	1.101	-.2	103.4	78.8	.5819	1.7	112.9	50.3	.1986	+16.1
40	99.9	104.6	1.097	-.6	101.7	77.8	.5852	2.3	103.6	49.0	.2237	+30.8
50	98.0	102.9	1.103	.0	98.8	77.4	.6137	7.3	101.2	49.4	.2382	+39.3
60	95.5	100.00	1.097	-.6	97.5	76.7	.6169	8.2	97.2	53.4	.3029	+77.0

TABLE - III

Temp. °C	OXYGEN			LAWRENCE GAS			HYDROGEN		
	Apparent Sp. Gr.	S_a Calculated	% Error	Apparent Sp. Gr.	S_a Calculated	% Error	Apparent Sp. Gr.	S_a Calculated	% Error
30	1.101	1.100	+.1	.5819	.5832	-.2	.1986	.1928	+2.9
40	1.097	1.098	-.1	.5852	.5916	-1.1	.2237	.2090	+7.0
50	1.103	1.095	+.7	.6137	.6059	+1.3	.2382	.2366	+ .8
60	1.097	1.090	+.6	.6189	.6281	-1.4	.3029	.2798	+8.2

Topping and Cracking of Panhandle Crude

A complete discussion of the possibilities of Panhandle crude when cracked

By Gustav Egloff and Jacque C. Morrell

Research Laboratories Universal Oil Products Company, Chicago, Illinois

ONE of the most interesting oil fields being developed at the present time showing great promise of high production, is that of the Panhandle field of Texas. The daily production of crude oil from the Panhandle section is approximately 50,000 barrels daily.

This oil is peculiar in that it has a high gasoline content and yet congeals at 50 degrees Fahrenheit. This congealing point of the crude brings about a piping problem of signal difficulty. To pipe this oil successfully over long distance calls for heating arrangements by internal or external heating of the pipe line or heavy insulation of the pipe line, dilution with lighter oil to cut down the viscosity, and frequent pumping stations. In summer weather, piping the high gravity Panhandle crude of high wax content is not a particularly difficult problem, although the pipe line runs would be materially reduced as compared with an equivalent gravity Mid-Continent crude. The real problem of transportation of this oil enters during cold weather conditions of the Panhandle and transcontinental parts of the United States.

It would appear rational in handling this crude oil that it be cracked in the field to increase the yield of gasoline, so as to eliminate the enormous expense involved in transporting this oil. The topping and cracking of Panhandle crude is a simple commercial operation and yields of gasoline of 70 per cent or more may be obtained with one passage of the oil through the cracking process.

Panhandle crude oil with its high wax content lends itself particularly to cracking by the Dubbs process. The present daily production of 50,000 barrels could be converted into 70 per cent gasoline. This is approximately 5 per cent of the total gasoline which will be produced during the year 1926, and the present daily production of 50,000 barrels could be handled by 25 cracking units.

Cracking this oil in the field would do away with the necessity of the highly expensive methods that will have to be devised for its transportation into refining centers, and the cracking of

this oil in the field would be highly economic.

A series of cracking tests were made on Panhandle crude oil and topped crude oil, for the purpose of determining the yields of gasoline by means of simultaneous topping and cracking the crude oil producing cracked distillate and coke, and also by topping the crude oil and cracking the residue.

These runs were made comparatively on the basis of producing just distillate and coke, and distillate, residual oil and coke.

The non-residual oil cracking test on the crude oil showed 70 per cent of Navy end point gasoline and when cracking on a residual oil basis of Navy Standard fuel oil, the precentage of gasoline based on the crude oil was 63 per cent.

The cracking of topped Panhandle crude oil on a non-residual oil basis showed a yield of gasoline of 65 per cent and when operating so as to produce Navy Standard fuel the yield of gasoline was 55 per cent.

The Panhandle crude oil used during the cracking tests analyzed as follows:

A. P. I. Gr., 36.6 per cent; color, black; sulphur, 1.1 per cent; water, 1.37 per cent; flash, atmosphere temp.; fire, atmosphere temp.; furol; viscosity, 77 degrees 22 sec.; cold test, 50 degrees F.

Gasoline—26.5 per cent; A. P. I. Gr., 58.4; color, 30+; I. B. P., 138 degrees F.; E. P., 425 degrees F.; sulphur, 0.15 per cent; corrosion, Neg.; doctor, Neg.

Kerosene—16.0 per cent; A. P. I. Gr., 41.4; color 18+; I. B. P., 378 degrees F.; E. P., 594 degrees F.; flash, 156 degrees F.; doctor, Neg.

Fuel Oil—56.0 per cent; A. P. I. Gr., 27.5; I. B. P., 568 degrees F.; sulphur, 0.61 per cent; B. T. U. per lb., 17,779; flash, 328 degrees F.; fire, 376 degrees F.; furol; viscosity, 77 degrees 320 sec.

Wax—6.3 per cent.

Cracking Results

The 36.6 A. P. I. gravity crude oil was charged direct into the still and cracked at 135 pounds pressure. In one run 88.3 per cent of distillate was obtained from the crude charged, this distillate being made up of the natural gasoline contained in the crude plus the pressure distillate obtained from the cracking operation. Fractionation of the cracked distillate produced 70 per cent of Navy End Point gasoline based upon the crude oil charged into the cracking unit; 14.2 per cent of gas oil or pressure distillate bottoms was made at the same time. This run was a no-residuum operation, that is, no other products were made but coke, pressure distillate and gas.

Another run made upon the same crude oil in the same manner for the purpose of producing a marketable fuel oil residue while simultaneously cracking and topping the crude oil, showed a yield of 62.3 per cent Navy End Point gasoline; 15.8 per cent of marketable fuel oil residue was made at the same time. This fuel oil residue had the following characteristics:

Flash	Fire	Furol Viscosity 77°F. 15 seconds	B. S. Benzol Dilution 0.2%	Cold Test
140°F.	190°F.			Below 0°F.

The summary of results obtained from the two types of operation is as follows:

Distillation Analysis of Products Non-Residual Oil Type Cracking

	Pressure Distillate	Gasoline N. E. P.	Gas Oil (P. D. Bottoms)
Grav. °A. P. I.	54.4	56.9	33.8
I. B. P. °F.	76°F.	116°F.	475°F.
E. P. °F.	79.2%—445°F.	439°F.	798°F.
Charge, cc	800	100	100
Unsats. Per Cent	13.0	11.0	
Condenser °F.	Water	Ice & Water	Water

Pressure, Lbs.	135	135
Kind of Oil	Crude	Crude
A. P. I. Gr.	36.6	36.6
Pressure Distillate		
A. P. I. Gr.	54.4	57.0
Per cent of Crude Oil	88.3	76.3
Residuum		
A. P. I. Gr.	None	28.3
Per cent of Crude Oil		15.8
Coke, lbs. per bbl.	31.9	15.5
Gas, Cu. Ft. per bbl.	189	176
Coke, Gas and Loss	11.2	7.4
Water, per cent Crude Oil	0.5	0.5
Gasoline (N. E. P.)		
Per Cent of Crude Oil	70.0	63.2
A. P. I. Gr.	56.9	58.0
I. B. P.-E. P. °F.	116-439	120-440
Gas Oil		
Per Cent of Crude Oil	14.2	8.3
A. P. I. Gr.	33.8	35.7

Remarks

Trace of water
25.5% @ 410°F.
16.5% 410°F. to 572° F.
94% Over
4.1% Coke (by wt.)
H_2S present

Per Cent Over	Temp. °F.	Temp. °F.	Temp. °F.
5		154	480
10	159	175	488
15		192	494
20	204	205	498
25		221	500
30	240	233	505
35		248	510
40	274	260	515
45		272	520
50	312	285	525
55		298	535
60	349	308	543
65		316	552
70	400	338	564
75	72.2–410	350	575
80	79.2–445	367	592
90		399	645
95		420	710
98		439	798

Distillation Analysis of Crude Oil

Grav. Sp. 8418

Remarks

72.2% @ 410°F. API 58.7
23.1% Bottoms API 34.0
4.7% Loss

79.2% @ 445°F. API 56.9
16.1% Bottoms API 33.8
4.7% Loss

98% Over
1% Botts.
1% Loss

98% Over
2% Botts.

Distillation Analysis of Products, Residual Oil Type Cracking

	Pressure Distillate	Gasoline N. E. P.	Gas Oil (P. D. Bottoms)	Residuum
Grav. Sp.				.1941
Grav. A. P. I.	57.0	58.0	35.7	23.3
I. B. P.	75°F.	120°F.	480°F.	395°F.
E. P.	82.8%—450°F.	440°F.	745°F.	780°F.
Charge, cc	800 cc	100 cc	50 cc	100 cc
Flash Cleveland				140°F.
Fire Open Cup				190°F.
Cold Test				Below 0°F.
Furol Visc. 77°F.				15 sec.
Unsats. per cent	12	12		
Condenser °F.	Water	Ice & Water	Water	Water
Benzol, B. S. per cent				0.2

Gravity Degrees A. P. I.	36.6	85	382	608
I. B. P. Degrees F.	164°F.	90	399	645
E. P. Degrees F.	736°F.	95	420	710
Charge, cc	100	98	439	798
Condenser °F.	Water			

Per Cent Over	Temp. °F.	Per Cent Over	Temp. °F.	Temp. °F.	Temp. °F.	Temp. °F.
10	270	5		159		415
20	343					

10	151	178	495	427
15		195		440
20	195	210	500	450
25		221		468
30	228	233	510	480
35		245		492
40	257	256	522	508
45		268		520
50	288	281	531	532
55		292		545

edied by injecting ammonia into the system, or feeding a small proportion of caustic soda in with the crude.

Coke and Gas Formation

The following tabulation shows the rate of coke and gas formation in the cracking of Panhandle crude by the above two types of operation:

Type of Operation—	Coke Lbs. Per Gallon	Coke Lbs. Per Barrel	Gas Cu. Ft. Per Gallon	Gas Cu. Ft. Per Barrel
No-Residuum	0.76	31.9	4.5	189
Fuel Oil Residue	0.37	15.5	4.2	176

60	330	303	540	560
65		314		580
70	374	329	598	605
75		343		634
77.3	410			
80		358	628	676
82.8	450			

Treatment of Cracked Distillate

The combined distillates from the topping and cracking operation were treated by the simple sulphuric acid, and plumbite method in the following manner:

The distillate was first treated with four pounds of 66° Baume sulphuric acid per barrel and the sludge withdrawn. This quantity of acid can be reduced by re-use of the sludge. The acid treated distillate was water-washed, and after withdrawing the water the oil was neutralized with approximately 1% of a 12 to 16° Baume plumbite solution. The treated distillate was then redistilled in the presence of steam supported by fire. The resulting gasoline product was water-white, negative to the doctor and corrosion test, and stable on long exposure to direct sunlight.

Remarks

77.3% @ 410°F. API 59.5	97% Over	99% Over	4% @ 410°F.
16.4% Bottoms API 36.9	1.5% Botts.	1% Botts.	59% @ 410°F. to 572°F.
6.3% Loss	1.5% Loss		94% Over
			7.6% Coke by wt.
82.8% @ 450°F. API 58.0			22% flashed off
10.9% Bottoms API 35.7			
6.3% Loss			

85	379		711
90	398	660	760
94			780
95	527		
97	440		
99		745	

Salt Water in the Crude

The crude oil as received contained emulsified water therein with various salts dissolved in the emusified water. The per cent of water in the crude was 1.37, although this figure will vary somewhat. The inorganic residue based on the crude oil was 0.128%, making a total of 447 lbs. per 1000 bbls. of crude.

A qualitative analysis of the residue showed the presence of calcium, magnesium and sodium chlorides, the former in relatively large amounts. Silica was absent from this residue.

The direct cracking of the crude oil in the heat exchange apparatus of the cracking system or the direct topping equipment might cause some corrosion of the equipment, owing to the formation of hydrogen chloride evolved as a result of the hydrolysis of the magnesium and calcium chlorides at elevated temperatures. This may be rem-

Unsaturated Hydrocarbons	Aromatic Hydrocarbons	Naphthene Hydrocarbons	Paraffin Hydrocarbons	Aromatic Hydrocarbon Equivalent	Maximum Compression Ratio
12.8%	17.6%	11.6%	58.0%	23.1	5.54

Chemical Analysis of Finished N. E. P. Gasoline from No Residuum Cracking of the Crude Oil

The gasoline was analyzed for the various hydrocarbon groups according to the method published by the authors (Industrial and Engineering Chemistry, Vol. 18, No. 4, page 354, April, 1926).

The results of this analysis are tabulated below:

The aromatic hydrocarbon equivalent shown above indicated this gasoline to be the motor equivalent in anti-knock properties of a Mid-Continent straight-run gasoline containing 14% of commercial benzol.

Cracking of Topped Crude Oil

As it may be desirable where crude oil topping equipment is already installed to top the crude oil first and crack the topped crude residue, two cracking runs were made showing the results when cracking upon a no-residual and residual oil basis.

The oil was first topped, taking off 26.5% of navy gasoline. The residue from the topping operation was then subjected to cracking.

The first run was made on a no-residual oil basis, produced 82.9% pressure distillate from which a gasoline yield of 65.3% based on the topped crude or 46.7% based on crude oil as received was obtained. The total gasoline yield from the topping of the crude oil and cracking of the topped crude was 73.2% based on the crude oil.

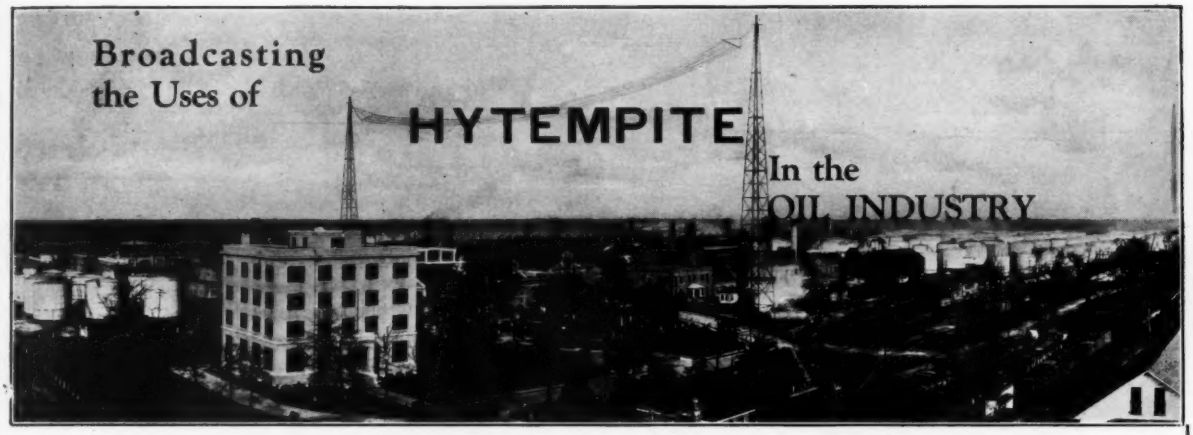
The second run, which was made at the same pressure, but on a 20% residual basis, produced 71% of pressure distillate from which a gasoline yield of 55.3%, based on the topped crude oil or 38.7% based on the crude as received, was obtained. The total gasoline yield from the topping of the crude oil and cracking of the topped crude was 65.2% based on the crude oil as received. The 20% residual oil produced in the above operation analyzed as follows:

Flash	Fire	Furol Viscosity 77°F.	B. S. Benzol Dilution	Cold Test
170°F.	200°F.	10.5	Trace	Below 0°F.

The following tabulation summarizes the two cracking runs made on the topped crude:

Pressure, Lbs.	135	135
Kind of Oil	Topped Crude	Topped Crude
A. P. I. Gr.	29.7	29.7
Pressure Distillate		
A. P. I. Gr.	53.3	55.9
Per cent Topped Oil	82.9	71.0
Residuum		
A. P. I. Gr.	None	25.3
Per cent Topped Oil		20.0
Coke, lbs. per bbl.	29.2	15.6
Gas, Cu. Ft. per bbl.	252	170
Coke, Gas and Loss	17.1	9.0
Gasoline (N. E. P.)		
Per cent Topped Oil	65.3	55.3

Type of Operation—	Coke Lbs. Per Gallon	Coke Lbs. Per Barrel	Gas Cu. Ft. Per Gallon	Gas Cu. Ft. Per Barrel
No-Residuum	0.52	29.0	6	252
Fuel Oil Residue	0.37	15.5	4	168



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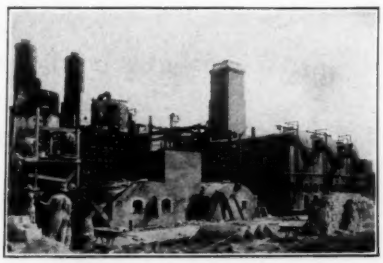

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Quotation from the Oil and Gas Journal (article by Mr. C. O. Willson), page 39, issue of June 17, 1926.

"Distillate Prices for Coming Season

"Buyers and Sellers Unable to Agree on Contract Terms

"Several Factors Will Determine Future Market Trend

"The large number of burner installations point to an increase in consumption of from 25 to as high as 50 per cent in different parts of the country.

"In the Middle West few, if any, contracts are being made with consumers because of the uncertainty which exists in regard to the open market tank car price at refineries. The latter fear that prices will be much higher and are unwilling to contract on the basis of former years."

The quotation on the opposite page confirms our oft-repeated assertion and indicates positively that the increasing demand for distillates is a definite and permanent trend which cannot but deplete the earnings of every cracking process but the Dubbs

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A. P. I. Gr.	56.3	57.7
I. B. P.-E.P.	117-437°F.	115-430°F.
Gas Oil		
Per cent Topped Oil	14.1	11.7
A. P. I. Gr.	33.2	35.8

Coke and Gas Formation

The following tabulation shows the rate of coke and gas formation in the cracking of Panhandle topped crude by the above two types of operation.

Treatment of Cracked Distillates from Topped Crude Oil

Water white, doctor sweet and stable gasolines were obtained from the two runs by the simplest chemical treatment, consisting of agitation with four to six pounds of 66° Baume sulphuric acid, removing the sludge followed by a slight water wash and neutralization with 1% by volume of 12° to 16° plumbite solution. The treated oil following this step is charged directly to the still where the finished gasoline is removed by steam and fire distillation.

Chemical Analysis of Finisher N. E. P.

Gasoline From No-Residuum Cracking of the Topped Crude

The following tabulation shows the chemical analysis of the finished Navy end point gasoline according to the method previously referred to.

Unsaturated Hydrocarbons	Aromatic Hydrocarbons	Naphthen Hydrocarbons
24.6%	18.8%	6.0%

Distillation Analysis of Products, Non-Residual Oil Type Cracking. Topped Crude Oil

	Pressure Distillate	Gasoline N. E. P.	Gas Oil (P. D. Bottoms)
Grav. °A. P. I.	53.3	56.3	33.2
I. B. P.	85°F.	117°F.	453°F.
E. P.	78.8%—440°F.	437°F.	697°F.
Charge, cc	800 cc	100 cc	100 cc
Unsats. per cent	16	18	
Condenser °F.	Water	Ice and Water	Water

Paraffin Hydrocarbons	Aromatic Hydrocarbon Equivalent	Ricardo Compression-ratio
50.6%	25.2	5.61

The gasoline produced by cracking the topped crude oil and blending the pressure distillate with the tops from the crude has an initial boiling point of 121°F. and an end point 436°F., with an A. P. I. gravity of 56.7. The cracked gasoline possesses anti-knock characteristics equivalent to a good grade of Mid-Continent straight run gasoline to which 17% of benzol has been added.

Distillation Analysis of Topped Crude Oil

A. P. I. Gr.	29.7
I. B. P.	425°F.
E. P.	760°F.
Charge, cc	100 cc
Flash Cleveland	210°F.
Fire Open Cup	250°F.
Furol Visc. 77°F.	52 sec.
Condenser F.	Tap Water

Per Cent over	Temp. °F.
10	495
20	557
30	615
40	652
50	700
60	723
70	738
80	750
90	760
95	745

Remarks

71.0% @ 410°F. API. 58.0
24.8% Bottoms API. 34.6
4.2% Loss
78.8% @ 440°F. API. 56.3
17.0% Bottoms API. 33.2
4.2% Loss

98% Over
1% Bottoms
1% Loss

98% Over
2% Bottoms

Distillation Analysis of Products, Non-Residual Oil Type Cracking. Topped Crude Oil

	Pressure Distillate	Gasoline N. E. P.	Gas Oil (P. D. Bottoms)	Residuum
Grav. Sp.				.9242
Grav. °A. P. I.	55.9	57.7	35.8	21.6
I. B. P. °F.	76°F.	115°F.	461°F.	375°F.
E. P. °F.	77.9%435°F.	438°F.	681°F.	775°F.
Charge, cc	800	100	100	100
Unsats. per cent	18	18		
Cold Test				Below 0°F.
Condenser °F.	Water	Ice & Water	Water	Water
Flash Cleveland				170°F.
Fire Open Cup				200°F.
Furol Visc. @ 77°F.				10.5 sec.
B. S. per cent				Trace

Per Cent Over	Temp. °F.	Temp. °F.	Temp. °F.	Temp. °F.
5		157	465	
10	159	170	476	
15		190	478	
20	212	207	480	
25		225	483	
30	251	240	487	
35		253	491	
40	292	269	495	
45		282	499	
50	328	295	503	
55		308	507	
60	362	318	511	
65		332	524	
70	405	345	533	
72.3	410			
75		356	538	
77.9	440			
80		370	551	
85		382	570	
90		399	599	
95		419	663	
98		437	697	
99			681	

Remarks

23% Over @ 572°F.
95% Over
4.3% Coke by wt.

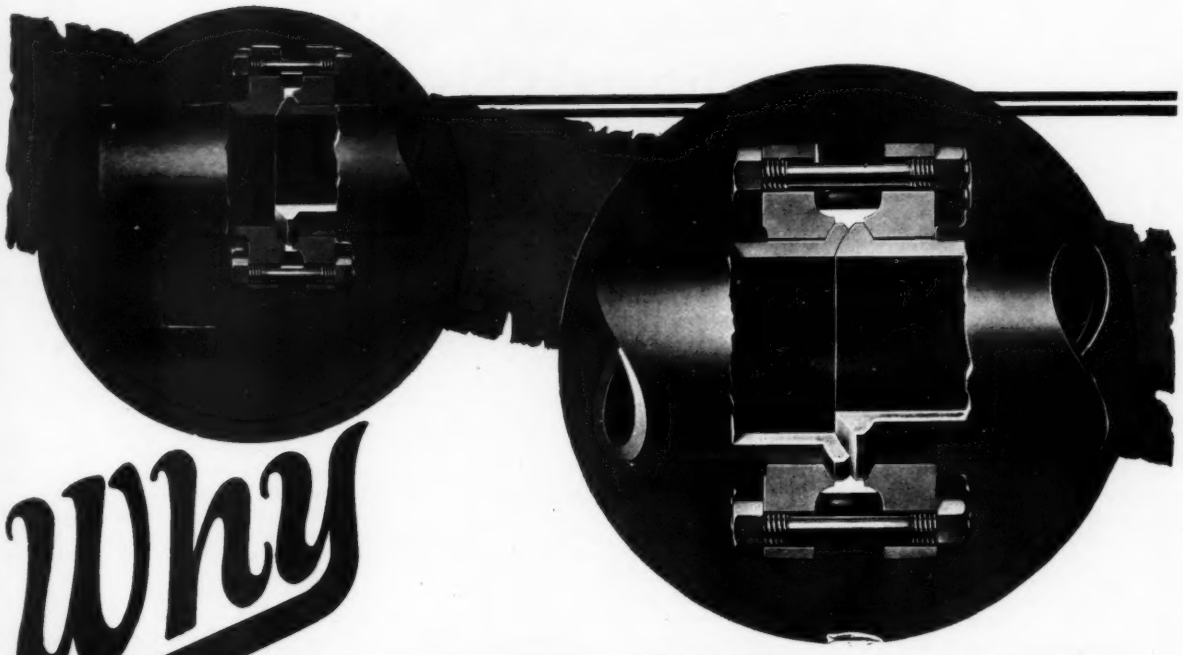
72.3% @ 410°F. API. 59.1
22.1% Bottoms API. 35.7
5.6% Loss

77.9% @ 435°F. API. 57.7
16.5% Bottoms API. 35.8
5.6% Loss

98% Over
1% Botts.
1% Loss

99% Ovef
1% Botts.

4% @ 410°F.
54% from 410°F. to 572°F.
92.5% Over
9.5% Coke by wt.



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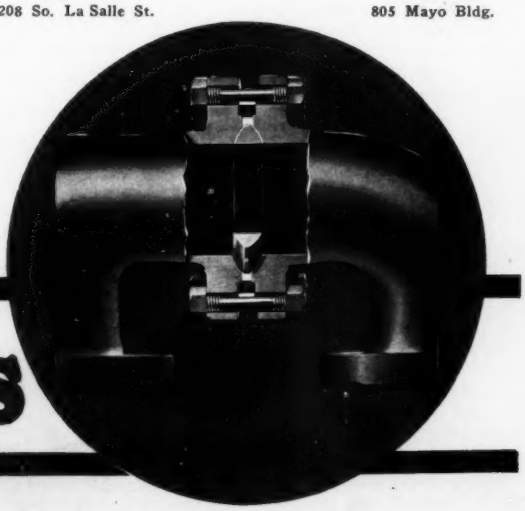

MIDWEST Joints

Neutralizing and Bleaching Mineral Oils

By Ismar Ginsberg

THE natural bleaching oils, as is very well known, are commonly silicates of alumina. In the early days of the mineral oil industry these earths were not used, but instead the residues recovered in the manufacture of potassium ferrocyanide and English fullers earth were employed. Then the American bleaching earths made their appearance and this was followed by the development of various synthetic bleaching materials which were promoted by German chemical companies. These bleaching earths have been found to be composed of silicic acid principally admixed with magnesia, lime, iron and also alkalies. The bleaching power of these products compares favorably with that of the American or English bleaching earths.

It has been found at times that it would be desirable to have bleaching earths which possess a higher degree of decolorizing capacity. Various experiments have been made along these lines and reference is here made to certain important considerations in this connection described in an article published in Petroleum Zeitschrift, 1926, pages 171 following.

In order to be able to improve the bleaching quality of the artificial bleaching materials, it is necessary to make a study of the manner in which these clays were formed in nature. Thus it is probable that the clay was first found in the form of porphyry or feldspar. The action of the carbon dioxide in the atmosphere and of moisture produced a weathering of the rock and also a decomposition which had the effect of washing out all the alkali with the result that a rich aluminum silicate was formed. There is still present however, about one to two per cent of alkali. It therefore may be concluded that the work of nature has not been completed and that it is possible to accelerate the action of the carbon dioxide and moisture in the air by an artificial process. Hence in the place of the weak carbonic acid strong mineral acids are employed. It must be expected that similar to the production of bleaching properties in the crude rock by the action of the weather and air the action of mineral acids will bring about even greater bleaching effects.

Bleaching Strength

The experiments proved conclusively that when the raw materials were suitably treated with the aid of mineral acids a change took place which had the effect of increasing the decolorizing properties of the earth by two or threefold. The earths are known as the Bayer earths, and the interesting problem is why do these earths bleach the oils with which they come in contact and what is the mechanism of the activating process.

The raw silicates contain water of hydration besides aluminum silicate and the other ingredients, as mentioned above. The assumption can be made that this water of hydration determines the content of silicic acid hydrate and that this is the bleaching factor. However, inasmuch as it has been proven that the pure hydrated silicic acid does not always possess bleaching powers, it must be assumed that the water of hydration is present in the form of hydrosilicates.

When a comparison of the analysis of the crude silicate and the prepared silicate is made, the following is found. The percentage of alumina is reduced by about one to two per cent, and furthermore a certain amount of alumina has also gone into solution. Lime and magnesia have disappeared almost entirely and the alkalies have completely been removed. The percentage of silicic acid has increased to a certain degree, naturally because of the reduction of the amount of bases present in the substance, but not in actuality. But the water of hydration has also increased. Hence hydrogen has entered into the compound in the place of the bases. In other words the percentage of hydrosilicate has been increased. This theory is substantiated by the fact that when the activated earth is neutralized with a very small amount of alkali the increased bleaching properties of the earth are again lost, for again a base supplants the hydrogen in the compound with the result that the character of the hydrosilicate is again destroyed.

There is also a second explanation that can be applied to the process of activation of earths. This is based on the assumption that the increase in the amount of water of hydration in the activated earth is greater than that in the bases that go into solution. Hence water of hydration must have been produced in another manner. Albert Loeb says in this case hydration of a silicate must be considered to have taken place and not the formation of free hydrated silicic acid. For the content of silicic acid hydrate can amount to only four to five per cent and accordingly pure silcic acid hydrate must have about twenty times the bleaching action. This is however not the case, for we know that pure silicic acid hydrate does not always possess bleaching powers. Mention need only be made of silica gel which is made by the precipitation of water glass with acid and drying of the precipitate that is thus formed. This material does not possess bleaching powers. It is used, as is known, primarily for the adsorption of gases and vapors.

Selection Important

The treatment of the artificial bleaching earths was carried out with the aid of hydrochloric acid or sulphuric acid. It is not always correct to use these acids in the strongly concentrated condition. It is also possible to work with dilute acids, solutions containing no more than three per cent of the acid. Of course in these cases satisfactory results are obtained only when the treatment of the earths is greatly prolonged.

It must be said that a distinction must be made between two kinds of bleaching earths. First there is the chemically treated and then there is the untreated. It must also not be thought that it is possible to use the activated earths for all purposes. This is not so by any means. The right type of earth must be selected for the proper purpose. Thus the non-treated earths are particularly suited for bleaching the food oils, and they are also advantageous in the treatment of acid oils, that is, oils containing traces of acid. On the other hand the treated oils are suitable for all other purposes, wherein it is desirable to destroy the color that is present in dark oils. The greater bleaching powers of these earths make them particularly suitable for this purpose.

Decolorizing Power

From the standpoint of the refiner it is natural that he should endeavor to secure the bleaching effect that he wants to obtain with the minimum consumption of the earth. The less earth used, the more economical the process. Hence he will be interested in using the earth which has the highest bleaching quality. How to determine which preparation is the better from this standpoint is another problem. Not always is the chosen method correct. The general procedure it to take a sample of the oil to be purified, and mix it with five per cent of one earth, and then with five per cent of another earth and compare results. The earth producing the lighter color is then considered to be the better from the bleachability standpoint. It is however true that such a test will not always give the correct conclusion. Furthermore the test is not quantitative and unless quantitative results are obtained, it is patently impossible to tell whether a more expensive and more powerful bleaching earth is not the actual cheaper of two earths that vary in price. The real conclusion that has to be reached is not how much of a bleaching effect five per cent of one earth will produce in comparison with five per cent of another, but rather how much of the various bleaching earths, that are being compared, will be required to produce a certain decolorization. This is after all what the oil man desires to know for practical purposes and it is only reasonable to carry out the preliminary test on the earths in the same manner.

It is also natural that the technically trained should endeavor to express the bleaching capacity of earths in numerical terms. In other words he would like to express decolorizing power as a co-efficient, just as he meausres viscosity of oils,

(Continued on page 62)

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The Distillation of Lubricating Oils Under High Vacuum[1]

By Benjamin T. Brooks

RECENT industrial developments in the art of distilling lubricating oils *in vacuo* have aroused considerable interest both in this country and in Europe. The object of this paper is to point out wherein these new developments differ from the much older, well-known vacuum distillation processes.

The outstanding characteristic of the recently developed process is the very high vacuum employed—i. e., an absolute pressure which in actual practice is 3 to 5 mm. of mercury. The old practice of vacuum distillation, which was first carried out on typical light crudes rich in paraffin wax—Pennsylvania petroleum—did not employ a high vacuum as we now understand that term. Most of the early patents did not specify or in any way definitely characterize the degree of vacuum employed. The advantages gained in the older practice were considered by many to be outweighed by other considerations, and fire distillation with steam came to be the customary procedure, though a few of the eastern refiners have continued the vacuum process. The general opinion of it, however, is reflected in the various descriptive publications and books describing refinery processes.

Redwood[2] dismisses the subject with the following sentences:

"Continuous as well as intermittent distillation of lubricating oil base is frequently conducted under high avcuum, a lower still-temperature being in this way obtained than by the ordinary steam distillation at atmospheric pressure. The resulting distillates are paler in color and of higher flashing points. Some difference of opinion exists, however, as to the improvement being sufficiently great to warrant the extra expense."

A small cast-iron still is shown connected to a water-jet air pump.

Bacon and Hamor[3] give fifteen lines to the subject and state:

"It has long been known that there is an improvement over the results of the ordinary methods, both in the quantity and quality of the distillation products, when vacuum distillation combined with steam distillation is used. However, many American refiners, who are familiar with the results which can be obtained by the vacuum method, state that the difference is not great enough to warrant the increased cost of installation and operation."

Day[4] states: "A few American refineries operate reducing stills under a partial vacuum obtained by the aid of a vacuum pump. * * * Considering the cost of their installation, the advantages obtained over properly applied steam are doubtful."

History

Steinschneider, in an article entitled "New Improvements in the Field of Distilling High-Boiling Oils,"[5] stated that a vacuum of 690 to 720 mm. of mercury was employed. As late as 1922, Graefe[6] described what he termed high-vacuum distillation of the oils and tars from the distillation of brown coal, stating the vacuum to be about 680 mm. of mercury. Kissling[7] illustrates the apparatus employed by Steinschneider and shows that cooling water is passed through the dephlegmators and then into the water leg, and points out that if this water is warmed to 45 degrees C. (113 degrees F.) or higher water cannot be condensed under a vacuum of 90 per cent of the normal barometric reading. Singer[8] gives the conventional rather unfavorable opinion of vacuum distillation and states that if distillation at very high vacuum were to be carried out the handling of the enormous vapor volumes would involve great difficulties which would overbalance the gains of such operation. These opinions of Singer, as his language indicates, are speculative. The only vacuum specifically mentioned by Singer is 680 to 700 mm. of mercury. Scheithauer[9] refers to vacuum distillation as being carried out at 400 to 500 mm. and that water jets or vacuum pumps do equally well, for producing the vacuum. In 1924 Gurwitsch[10] gives a table of boiling points of heavy oils, calculated for vacuum as low as 5 mm. of mercury, but states that such operation "seems not to have made its appearance in the petroleum industry."

The foregoing notes are given rather fully to indicate the character of the vacuum heretofore employed and the prevailing opinions regarding vacuum distillation of lubricating oil.

Although the vacuum distillation plants installed in Europe by Steinschneider and his associates have apparently not employed an absolute pressure lower than about 40 mm. of mercury, they embody an improvement of importance. In this process[11] most of the heavy oil distillates are condensed and run to receivers which are not attached to the vacuum pump. In distilling lubricating oils at very low pressures it is found that if a small fraction of light oil and the uncondensed vapors and gases are taken off separately and kept out of the heavier distillates, these heavy oils do not darken in color on exposure to air. The lightest condensate is foul smelling and darkens quickly on exposure to air. Steinschneider provides for this operation as shown in Figure 1.

Distillation at Very Low Pressures

The advantages and markedly different results obtained by distilling lubricating oils at absolute pressures of 3 to 5 mm. as contrasted with former practice at 40 mm. or higher, appears to have been first shown, and the practicability of so operating industrially first demonstrated, by John E. Schulze.

The effect on the boiling point of lowering the absolute pressure is much more pronounced, for a given difference in pressure, at very low pressures than at moderate vacuum. A black car oil by Schulze illustrates this (Table I).

Table I—Distillation of Heavy Residuum in Vacuo

Absolute pressure Mm. Hg.	Per cent over at 572° F. (300° C.)	Initial b. p. of fraction °F.
40	30	455
25	50	437
15	68	419
5	94	364

The rapid lowering of boiling points with decrease of absolute pressure, particularly at low pressures, below 40 mm., is shown by Fig. 2, recently given by Steinschneider.

It is, of course, true that at absolute pressures as low as 3 mm., the oil vapors occupy a large volume, approximately 250 times the volume of atmospheric pressure, though this volume ratio is slightly reduced by the lower distillation temperatures resulting from the low pressure. In order to provide for this large vapor volume and prevent the choking effect which would result from the usual still construction, Schulze provides as many as ten vapor outlets, 10 inches in diameter each, on each 10x30-foot vacuum still. With this multiplicity of vapor outlets the still shows practically the same absolute pressure, within 1 mm. as shown by the manometers on the receivers and on the lines adjacent to the vacuum pumps. These outlets dip slightly away from the still, considerable condensation being effected by air cooling before passing to the water-cooled condenser, which functions as much as a cooler as a condenser. Somewhat less than 1 per cent of light, volatile, malodorous oil is taken off in a separate overhead line, leading to a separate condenser; this overhead vapor and gas line is directly connected to the vacuum pump. The bulk of the distillate flows by gravity to a series of receivers which are evacuated at the beginning of the run, the evacuation being back through the condensers and light over-

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[1]Reprinted from Industrial and Engineering Chemistry, August, 1926, and presented before the division of Petroleum Chemistry of the American Chemical Society, Tulsa, Oklahoma, April 5 to 9, 1926.

[2]"Petroleum," 2nd ed., 1922, Vol. II, p. 507.

[3]"American Petroleum Industry," 1916, Vol. II, p. 458.

[4]"Handbook of the Petroleum Industry," 1922, Vol. II, p. 353.

[5]8th Intern. Cong. Appl. Chem. 25, 735 (1912.)

[6]Brennstoff-Chem., 3, 167 (1922.)

[7]"Chemische Technologie des Erdols," latest edition.

[8]Petroleum Z., 10, 605 (1915).

[9]"Die Schwelteere," Leipzig, 1911, p. 68; "Die Fabrikation der Mineralole," p. 103.

[10]"Wissenschaftliche Grundlagen der Erdolverarbeitung," 2nd ed., 1924, p. 205.

[11]Steinschneider, U. S. Patent 981,953 (1911).

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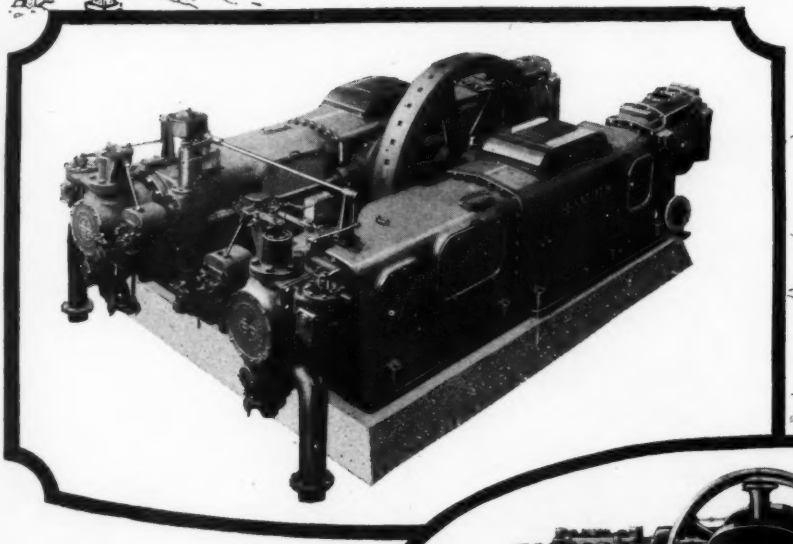

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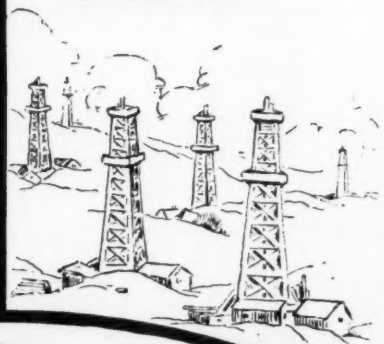

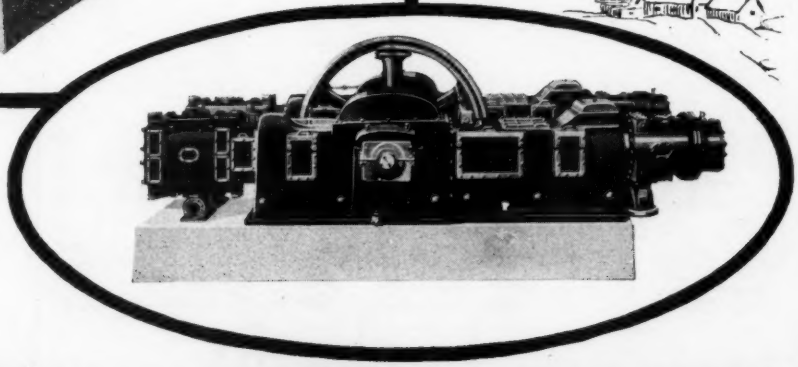

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head line to the vacuum pump. The stills and all the lines are welded throughout, with the exception of the manholes on the stills and the large gate valves in the oil lines connecting the various receivers, these valves being screwed in, not flanged.

The process is being operated both by the batch and continuous systems, using 10x30-foot stills suitably braced inside. Schulze has also adopted a type of furnace setting by which the stills are very uniformly heated, largely by radiant heat. Stills heated in this way which have been in practically continuous operation for about two years show no signs of buckling or having been locally overheated.

The vacuum pumps employed have been considerably improved to meet the requirements of this process. The power consumption is very small, two vacuum pumps being mounted on one base and driven by one 40-horsepower motor. Worthington "feather" valves are a noteworthy feature of these pumps, as is the pump design, which practically eliminates dead air space. The total power consumption at one plant, including lighting and incidental pumping, was 1.5 kilowatt-hours per barrel of crude charged.

Method of Operation

High-vacuum distillation is probably most advantageous in the case of wax-free oils, not only on account of the relatively low market value of such crudes, but also because the absence of paraffin wax makes the production of finished lubricating oils in this way an exceedingly direct and simple process. Gasoline and kerosene, if present, should be removed in a preliminary topping distillation and, although some gas oil may be taken over in this way, care should be taken not to crack the oil. Very heavy crudes, such as heavy Smackover oil, is first dehydrated and charged directly into a vacuum still, the gas oil distilled under a moderate vacuum and the vacuum is then raised to the usual operating pressure. In this method of batch operation the still temperatures may reach 575 degrees to 625 degrees F., depending upon the character of the oil and its resistance to cracking. The lubricating oil distillate thus obtained is emulsified with just sufficient concentrated caustic soda to combine with the naphthenic acids, and without separating these soaps the oil is redistilled at 3 to 5 mm., cutting the fractions according to the viscosity desired. These distillates are color stable and substantially odorless and tasteless as produced, without acid or any other treatment. In order to remove moisture and brighten these distillates, the receivers are provided with closed steam pipes by which means the oil is heated to about 200 degrees to 225 degrees F. and blown with air until bright. No other refining treatment is necessary if the charging stock has not been previously damaged by cracking and the distillation has been properly carried out.

Yields from Various Heavy Crudes

Owing to the high vacuum and the correspondingly low still temperatures employed, no loss by cracking or decomposition occurs; and the yields are appreciably greater than are obtainable by other refinery practice. Probably the maximum loss by cracking occurs in the prevailing method of distilling crudes of high wax content by fire alone. While this has the merit of cracking most of the amorphous wax and thus facilitating the usual dewaxing operations, this cracking of lubricating oil and the resulting necessary acid refining probably averages more than 2 gallons per barrel of crude. However, there seems to be some question as to whether lubricating oils of satisfactory cold test can be made by the direct high-vacuum distillation of wax-bearing crude oils; no plants are operating in this way on such oils, so far as the writer is aware. An alternative method is to redistill the dewaxed unfinished lubricating oils, as ordinarily produced, by the high-vacuum method. If such oils are not too highly cracked, finished lubricating oils, not requiring acid treatment, can thus be made. while the maximum advantage of the high-vacuum distillation method is not realized in this combined operation, there is an added advantage in the quality of the lubricating oils so produced. The question of quality is discussed later.

Some of the results obtained by Schulze on commercial operation follow:

Smackover Crude, from Nevada County, Ark.	
Gravity,° A. P. I.	18.6
Flash, °F.	115
Fire, °F.	190
Viscosity at 100° F.	445
Sulphur, per cent	3.3
	Per cent yield
Gas oil, 29.6° A. P. I.	28.9
Finished lubricating oil	32.15
Asphalt bottoms	37.5
Fuel oil	0.61

The composite lubricating oil had a viscosity of 287 at 100 degrees F. and showed a color of 2¼ N. P. A. The separate fractions showed viscosities ranging from 100 to 1500 seconds at 100 degrees F.

Topped Gulf Coast Crudes

A composite of topped Gulf Coast crudes, including Hull, Orange, Goose Creek, and Mirando crudes, from which 30 per cent of gas oil has been distilled, gave 77 per cent of lubricating oil distillate and 23 per cent of asphaltic residuum. The composite lubricating oil showed a viscosity of 552 at 100 degrees F. and 18.4 degrees A. P. I. On redistillation of this composite lubricating oil, the following yields were obtained:

Viscosity			Per cent of Topped crudes
129 at 100° F			13.8
350			11.2
70 at 210° F.			18.4
100			5.17
122			5.48
122			3.45

Topped Mirando Crude

	Viscosity		Per cent
Gas oil			23.0
Lubricating oil	100	at 100° F.	11.5
	200		20.0
	77	at 210° F.	26.0
	140		10.0
Asphaltic residue			9.0

Heavy Vinton Crude

Heavy Vinton crude, 18.8° A. P. I., yielded 42.4 per cent of unfinished lubricating oil distillate which on redistilling gave the following cuts:

Viscosity		Per cent of crude
88	100° F.	3.31
138		4.59
278		7.88
950		8.26
94	210° F.	8.46
146		4.77
186		1.84 (overhead)

Other Tests

Mexican crude from the Cacalilao field 12 degrees A. P. I. gravity and 3.8 per cent sulphur yielded 26 per cent unfinished composite lubricating oil and 50.05 per cent asphaltic residuum.

Quality of High Vacuum Oil Distillates

Many aspects of the question of quality of lubricating oils are warmly debated, and while commercial bias undoubtedly enters into such discussions, there are a

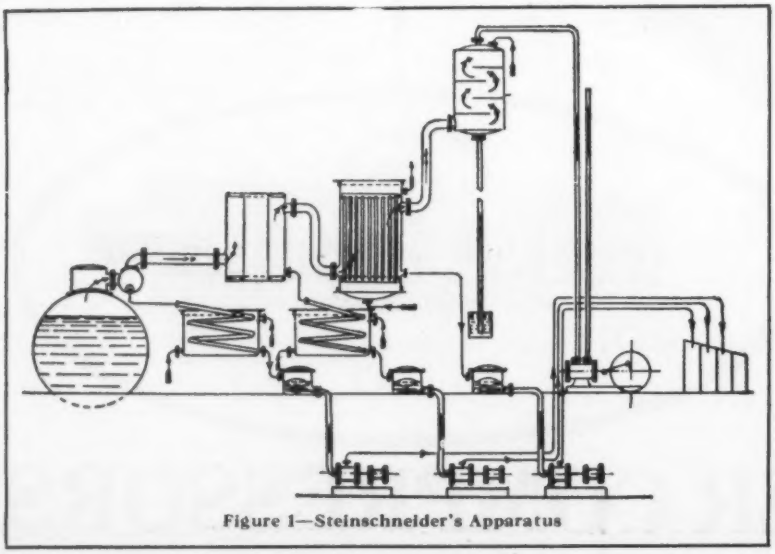

Figure 1—Steinschneider's Apparatus

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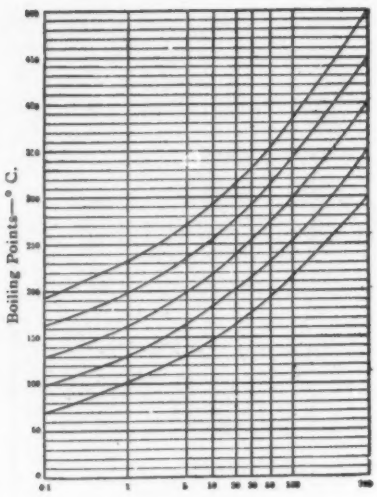

number of generally recognized tests which, taken collectively, are believed to be qualitatively, it not quantitatively, indicative of the quality of lubricating oils. Moreover, lubricants are put to such a variety of uses that the interpretation of the results of tests is a matter of great uncertainty. Some go so far as to waive all tests aside and assert that quality of an oil depends upon such vaguely defined properties as "oiliness" and selective adsorption, which so far have eluded all attempts at accurate definition and measurement. In this paper the usual commercial tests are given for a number of oils distilled under high vacuum and without chemical refining and the results of the same tests given for a number of the best known commercial oils now on the market. The tests given in Table II were made in the laboratory of one of the largest refining companies, and are believed to be correct within the pardonable experimental error of the methods employed.

Lubricating oils distilled by fire, or fire and steam, seldom have viscosities exceeding 350 seconds at 100 degrees F. On redistilling such oils under a very high vacuum, to prevent decomposition, the resulting fractions show a very wide spread in viscosity and the first fractions, amounting to to at least 10 per cent and frequently more than 20 per cent, show characteristics which class these light fractions with heavy gas oil. In order to obtain oils of relatively high viscosity as ordinarily manufactured, it is necessary to blend the distilled oils with residual oils such as refined bright stocks. The substantial amount of gas oil generally present in the distilled oils results in a very considerable sacrifice of viscosity, requiring much more bright stock to obtain blends of a given viscosity than would otherwise be necessary. The results of high-vacuum distillation analyses made by Mr. Schulze of three commercial oils which are fairly typical are shown in Table III. It will be noted that a commercial oil having a viscosity of 519 seconds contained 30 per cent of oil having a viscosity of 130 seconds and that the remainder had a viscosity of more than 1000.

[12]U. S. Patent 1,448,709.

Table III—Vacuum Distillation Analyses of Commercial Oils

	Original oil	Vacuum distillates			
		10%	20%	30%	90-95%
		Medium			
Gravity, ° A. P. I.	20.7	22.8	21.5	..	19.7
Flash °F.	340	265	310	..	475
Fire, °F.	415	320	370	..	565
Viscosity at 100° F.	341	64	111	..	2140
Color, N. P. A.	3	1.0	1.0	..	3
		500 Red			
		10%	20%	80-90%	90-95%
Gravity, °A. P. I.	19.3	22.5	20.5	17.8	17.8
Flash, ° F.	355	280	320	440	475
Fire, ° F.	420	315	375	540	565
Viscosity at 100° F.	503	65	123	2106	2793
Color, N. P. A.	6+	1½	1½	4	5
		Heavy			
			1st 30%		Next 65%
Gravity, ° A. P. I.	20.9		22		20.3
Flash, ° F.	365		320		420
Fire, ° F.	430		370		500
Viscosity at 100° F.	519		130		1001
Color, N. P. A.	4		1		2½

Table II—Tests on Commercial Oils Distilled under High Vacuum

Test	Gravity °Be.	Viscosity at 100° F.	Open Cup Flash °F.	Open Cup Fire °F.	Color N.P.A.	Carbon Conradson	R. E. No. Minutes*
			Light Oils				
1	23.8	204	360	420	3+	0.03	6
2	20.3	197	340	390	1½	0.03	6
3	25.0	235	380	450	3	0.12	9½
4	20.2	215	335	385	3½	0.23	5
5	22.4	250	370	415	5	0.14	3
6	25.5	200	395	470	2½	0.05	4½
7†	20.7	200	370	440	2	0.02	< 1
			Medium Oils				
8	26.4	285	415	485	5	0.50	5
9	21.0	240	340	400	2	0.07	7
10	23.8	330	395	470	4	0.50	14
11	21.7	340	370	435	3½	0.13	2
12	20.5	583	360	425	7	0.20	17
13	24-26	300	415	480+	4	0.10	13½
	24-26	280-290	415+	480+	6	0.22	25
14†	20.2	300	380	450	2¼	0.03	< 1
15†	17.4	642	360	420	1¾	0.05	< 1
			Heavy Oils				
16	26.4	405	420	480	5	0.60	5
17	19.0	470	360	415	2	0.05	7
18	23.8	515	425	495	5	0.31	> 20
19	19.8	510	360	430	4	0.17	9
20	26.0	98 (210° F.)	460	555	8	0.64	11
21	22-24	449	420+	480+	6+	0.22	26
22	23-25	460-470	440+	505+	6+	0.28	35
23†	19.9	500	415	500	2½-3	0.05	< 1
24†	19.3	750	435	530	3½-¾	0.07	< 1
25†	18.9	1000	460	565	4	0.09	< 1
26†	...	175 (210° F.)	450	510	2¼	0.10	< 1
27 (Bright stock)	22-24	150-160 (210° F.)	520	600	D	2.10	High > 30

† High vacuum. *Minutes for emulsion to break.

Narrow Cuts Possible

One of the characteristics of the lubricating distillates produced by high-vacuum distillation is that the cuts can be made quite narrow, corresponding to a narrow range of boiling point and viscosity. In the usual practice gas oil is produced by cracking of the more valuable lubricating oils throughout the distillation period. It is the presence of these light decomposition products in very substantial proportions which gives such distillates their pronounced odor and taste, makes them discolor on exposure to air, and necessitates the use of sulphuric acid, alkali, and usually fuller's earth to put them in a marketable condition of refinement, as is well known. The troubles incident to the refining of lubricating oils with acid, alkali, etc., are too well known to warrant comment. That the color stability and other properties of the distillates produced by the Schulze process are such that no acid is required to refine them has already been noted. This color stability is also indicated by the fact that the final distillates can be heated to 250 degrees F. and blown with air until bright without darkening in color. The values reported for Conradson carbon and de-emulsification are also noteworthy.

Schulze[12] has pointed out that it is commercially feasible to obtain distilled oils having viscosities as high as 170 to 180 seconds at 210 degrees F. and that unblended distillates even approaching this viscosity have not been known in the industry heretofore. The still bottoms from naphthenic crudes, left behind after the usual distillation, yield large percentages of heavy lubricating oil distillates when distilled at 3 to 5 mm., this percentage being as high as 90 per cent in many cases. When the still bottoms or cylinder stock is derived from a paraffin-base oil, free from asphalt, Schulze has shown that about 60 per cent of such a product can be distilled to obtain distillates ranging from 400 to 900 seconds viscosity at 100 degrees F., color 2 to 5 N. P. A., and leaving a very novel, un-

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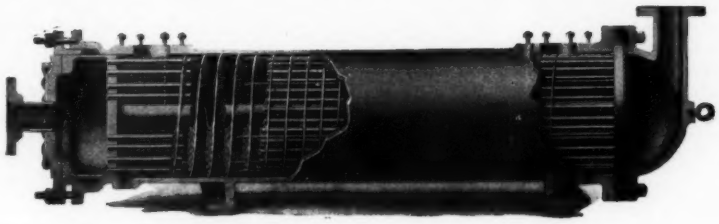

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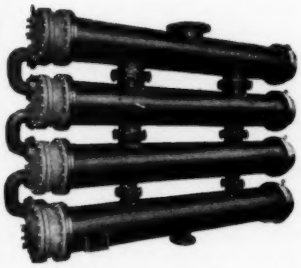

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damaged cylinder stock, an extremely viscous heavy oil, having a viscosity as high as 250 seconds at 212 degrees F., 630 degrees F. flash test, and about 700 degrees F. fire test.

The oils described in Table IV were obtained by Schulze by high-vacuum distillation, 1.5 mm. absolute pressure, from a quantity of ordinary still bottoms from naphthenic oils.

A further comparison of typical light, medium, and heavy commercial lubricating oils and high-vacuum distillates of about the same viscosity brings out certain differences and these differences were in part used by Schulze[12] in substantiating his claims as to the novel character of the distillates obtainable by distillation in a high vacuum (Table V).

Considerable interest has been shown in a recent paper on high-vacuum distillation by Steinschneider.[13] The work of Steinschneider and his associates, Singer and Porges, has already been referred to.[14] In this recent paper Steinschneider referred to plants operating in America, employing 5 to 25 mm. absolute pressure, but did not state what plants or particular processes he had in mind. In the published discussion of the paper Dvorkovitz stated that while partial vacuum had long been used at Baku the high vacuum referred to by Steinschneider had not been used; Jenkin also stated that, while operation at 20 to 45 mm. absolute pressure seemed possible, "none of the five or six benches of Bruenn-Koenigsfelder stills with which I am acquainted normally operate at anything like this vacuum. The usual pressure varies between say 75 mm. and 110 mm., and if for some special reason they manage to reach 50 mm. it is considered something of an achievement."

This important technical advance—i. e., large-scale oil distillation at absolute pressures of less than 5 mm.—has required the painstaking development of a new distillation technic. The process has definitely established itself in the petroleum industry and, although it seems that all important technical advances must suffer a certain amount of litigation, it appears to the writer from the publication, prior patent art, and other available information that the credit for this commercial development falls to John E. Schulze.

Table IV—Vacuum Distillates from Ordinary Still Bottom

Properties	Fraction (1)	(2)	(3)	(4)	(5)
Gravity, ° A. P. I.	18.5	18.2	18.0	17.5	17.0
Flash, ° F.	440	455	470	490	520
Flash range, ° F.	420–450	440–470	460–480	480–500	500–540
Fire, ° F.	530	545	560	575	600
Viscosity, seconds Saybolt at 212° F.	70	85	100	125	150
Viscosity range at 212° F.	60–80	80–90	90–110	110–140	140–170
Color, N. P. A.	4½	5	5½	6	6½
Pour test, A. S. T. M. ° F.	5	5	5	10	15
Initial boiling point, ° F.	475	490	520	550	575
All distilled over, ° F.	490	520	550	575	590

Table V—Comparative Tests of Typical Light, Medium, and Heavy Oils

	Ordinary Distillation Paraffin base	Ordinary Distillation Naphthene base	By high-vacuum distillation narrow cut
Light Oils			
Gravity, ° A. P. I.	30	21	21
Flash, ° F.	405	320	360
Flash range, ° F.	290–550	250–460	340–380
Viscosity at 100° F., sec. Saybolt	190	200	200
Viscosity range, 100° F., sec. Saybolt	60–600	60–2000	100–300
Color, N. P. A.	2½	2½	1½
Pour test, A. S. T. M., ° F.	30	Below zero	Below zero
Initial boiling point at 1.5 mm., °F.	374	320	400
Per cent distilled up to 450 °F., 1.5 mm.	10	60	98
Medium Oils			
Gravity, °A. P. I.	29	20.5	20.5
Flash, ° F.	425	330	380
Flash range, ° F.	300–550	255–480	370–430
Viscosity at 100° F., sec. Saybolt	260	300	300
Viscosity range at 100° F., sec. Saybolt	70–400	60–2200	200–450
Color, N. P. A.	3½	3	2
Pour test, A. S. T. M., ° F.	35	Below zero	Below zero
Initial boiling point at 1.5 mm., ° F.	410	350	435
Per cent distilled up to 475° F., 1.5 mm.	22	46	98
Heavy Oils			
Gravity, ° A. P. I.	28.5	19.5	19.5
Flash, ° F.	435	360	400
Flash range, ° F.	305–500	260–510	385–430
Viscosity at 100° F., sec. Saybolt	365	500	500
Viscosity range, 100° F., sec. Saybolt	75–1600	70–2400	400–700
Color, N. P. A.	5	3½	2½
Pour test, A. S. T. M., ° F.	35	Below zero	Below zero
Initial boiling point at 1.5 mm., ° F.	437	390	440
Per cent distilled up to 500 ° F., 1.5 mm.	35	56	98

[12] J. Inst. Petroleum Tech. 11, 514 (1925.)
[13] See also Porges, U. S. Patent 1,011,079 (1911); Steinschneider, U. S. Patent 981,953 (1911) and 1,162,729 (1915).

Acknowledgment

The writer wishes to express his indebtedness to Mr. Schulze for permission to publish much of the data in the present paper.

Wichita Pipe Line Co. Pays Five Per Cent Dividend

Wichita Falls, Texas.—Stockholders of the Wichita Pipe Line Company, which operates on a common carrier ba is in the North Texas district around Wichita Falls, were voted a five per cent cash dividend payable July 10 at a special meeting of the board of directors held July 2. The company was organized in February, 1924 and began running oil July 1, 1924, and during the two years of operation cash dividends totalling 40 per cent have been paid. The company has enlarged its pipe line activities during the past two years to a total of 175 miles of trunk and gathering lines, connecting with fields in Wichita, Archer, Young and Jack Counties. The entire stock is owned by independent refiners and producers.

The officers of the company are: Roy B. Jones, president; W. M. Priddy, vice-president; L. V. Hull, vice-president and general manager; P. F. Gwynn, secretary-treasurer; and A. W. Eichenberger, assistant secretary-treasurer. The board of directors include the above officers and W. W. Silk, B. J. Shaw, D. O. Johnson, W. F. Davis and O. H. Berryman.

E. J. Mary, refinery superintendent for the Simms Oil Company of Dallas, has resigned, effective September 1, to accept a similar position with the Shreveport Producing and Refining Company of Shreveport, La. Mr. Mary was formerly from Shreveport, having been connected with the old Caddo Central Company. The Shreveport Producing & Refining Company has a capacity of 5000 barrels crude per day. They also operate two Dubbs and one Jenkins cracking unit.

When it comes to picking a date for a glorious birth, the prize goes to Miss Bonnie Jean Kauffman. She arrived July 4, last, the first child of Mr. and Mrs. H. L. Kauffman, 1317 Pearl stret, Denver, Colorado.

Mr. Kauffman is a consulting petroleum chemist, whose writings appear frequently in *The Refiner and Natural Gasoline Manufacturer.*

Fred E. Hosmer, former supervising engineer in charge of the natural gasoline department of the Gulf Companies in Texas, Louisiana and Arkansas, is now engaged in consulting and construction work with headquarters at Fort Worth, and will shortly erect a small gasoline plant in the Central West Texas district.

S. B. Mosher, president of the Signal Gasoline Company of Los Angeles, is completing a tour of the Mid-Continent fields, inspecting gasoline plants of his own and other concerns.

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DEALING IN PERSONALITIES

Though born in Illinois in 1883, Harry J. Bauer might properly be called a native Californian, inasmuch as all but the first two years of his life have been spent in the Golden State. It was his early ambition to become a mining engineer, but after one year at the College of Mining of the University of California, he decided that the study of law offered greater opportunities for his development. Consequently, in 1909, he was graduated from the School of Law of the University of Southern California with the honor of being the best prepared and most thorough student in his class.

Beginning as a law clerk in the legal department of the Southern California Edison Company, Mr. Bauer rose rapidly as a result of his unusual ability to handle work of responsibility, and in a comparatively short time he was made general counsel of that great power company. In 1919 he resigned from the Edison Company to become senior member of the law firm of Bauer, Wright & Macdonald, which today stands among the highest in the ranks of the legal profession in Los Angeles. At this time Mr. Bauer also became general counsel for Wallace Refineries, a new company into which a number of small natural gasoline companies were merged. However, his first contact with the industry dates back to 1913, and subsequent years when he handled the legal matters connected with the formation and operation of many new companies which saw possibilities in the then infant business. From this, then, it is not too much to say that Mr. Bauer is a pioneer in the natural gasoline industry in California.

In 1921 the Pacific Gasoline Company, a Delaware corporation, was formed to take over the business of Wallace Refineries. Mr. Bauer was elected president and general manager of this new company and as a result of his administration and vision, coupled with the will to do, Pacific Gasoline Company has kept pace with development of the oil industry in California, and now ranks as the largest producer of natural gasoline in California and the third largest in the United States. This growth and success, if analyzed, would show the enthusiasm and earnestness of purpose of some several hundred or more employes, whose attitude toward the job at hand is merely a reflection of the traits of the guiding head of the organization. The qualities of kindness, consideration and fairness to others, and a desire to help those who are deserving to help themselves, are ever outstanding in Mr. Bauer throughout his business, professional and social life.

HARRY J. BAUER
President Pacific Gasoline Company, Los Angeles, Calif.

HARRY J. BAUER

His marked ability to work out financial and other problems has brought many calls upon his time. He is a director of the Southern California Edison Company and of the California Bank; a trustee of the University of Southern California, the school which did much to prepare him for his many future successes and responsibilities; a vice-president of the Chamber of Mines and Oil, and chairman of the Committee on Federal and State Affairs of the Los Angeles Chamber of Commerce. To the progress and welfare of these interests, and many others, he finds it possible to contribute something valuable.

Recreation finds its fair share of Mr. Bauer's time, and this balance of work and play is largely responsible for his good health and apparently inexhaustible energy. With Mrs. Bauer and his daughter, Dorothy, he may usually be found on summer week-ends at his seashore cottage or cruising out in the channel between the mainland and Catalina Island in his Yacht, Arrow. A comfortable cottage on his mountain ranch is also a favorite retreat from the stress of many cares and responsibilities. A crack shot and a good hunter, Mr. Bauer siezes every opportunity to get into the wild, back country. He usually manages to get his quota during deer season, and duck season will often find him out on the ponds. Sometimes he roughs it into distant hunting grounds with a small party of close friends for whatever game may be found. His last trip of this kind was productive of a bob cat, two mountain lions and a wild turkey.

Mr. Bauer is a good tennis player and a fair golfer, the former being his favorite game. He enters into these sports with the same earnestness that characterizes his business and professional work, and is constantly striving to improve.

His hobby, if he may be said to have one, is the study of guns and their ammunition. He has a collection of fine rifles and has studied cartridges to the extent of himself placing the powder and bullet in the shell to test certain theories he has worked out.

Finally, let it be said that Mr. Bauer is primarily a natural gasoline man, whose interest in the progress and welfare of the industry is his first concern.

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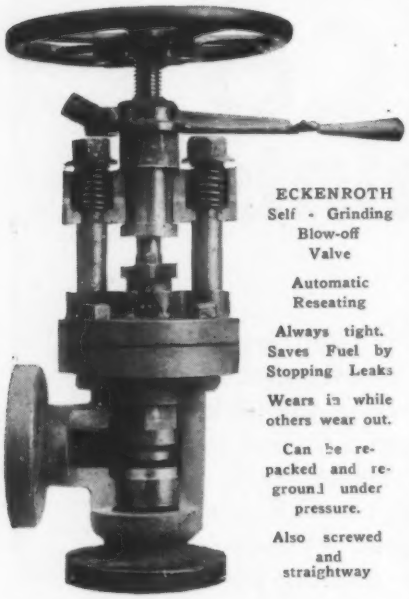

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Neutralizing and Bleaching Mineral Oils

(Continued from page 50)

or the flash and burning points of his petroleum distillate. This is commendable but it must be remembered that there are no units whereby he can measure bleachability of earths, and as long as there are no units available it is impossible to measure and express numerically the decolorizing power of bleaching earths. It may be possible to find a unit which would be a definitely determined earth of constant composition and unchangeable bleaching power. If such a substance were available, then the mensuration of the bleachability of earths would be materially simplified. Unfortunately no such earth has as yet been found, and the oil man must content himself with making comparative tests on the quantity of the earth required to effect a certain decolorizing action.

Absorbing Property

Another very important property of earths is their absorptivity. There is a relation between the volume of the earths and their absorptivities. Thus the greater the volume, the greater the absorptivity. When the specific gravity of the earth is high, then its absorbing qualities are low. This factor is of particular value.

Thus if the absorptivity of the earth is figured to be fifty per cent after the earth has been filtered, then the residue will contain half oil and half earth. For every hundred parts of earth, the same proportion of oil is held back. On the other hand if the absorptivity of the earth is only twenty-five per cent, then for every seventy-five parts of earth in the residue there will be retained twenty-five parts of oil. The value of the recovered oil must be taken into consideration in figuring which of the two earths should be employed as well as the price of the earths themselves. It will generally be found that it is decidedly advantageous to employ the less absorptive earth.

Another interesting property of the earth is the ease with which it filters. The rapidity of the filtration is a factor in the cost of the bleaching process and the clarity of the filtered oil is another. The penetrability of the material determines these factors. A bad filtering earth never gives a solid oil cake but also a slime which is rich in oil and the result is that the loss of oil is high. In general it is true that the activation of the bleaching earths results in rendering them more easy-filtering. However, the fineness of the grinding must not be increased over a certain maximum. It is true that the finer the particles of the earth, the greater the effective decolorizing area of the earth and the more potent the bleaching effect, but then the ease with which the earth is filtered is impaired. Hence it is necessary to choose a happy medium which will give good bleaching results and at the same time not retard the filtration process.

While the non-treated earths are neutral, nevertheless they possess a basic character in that they contain small amounts of ingredients that are easily decomposed by acids. The prepared earths can be washed with water until the acid content is reduced to as low as 0.02 to 0.03 per cent, and often to as low as 0.01 per cent. However it is not possible to neutralize them completely, for if that were done the bleaching powers of the earth would be impaired. It is claimed that the presence of this small amount of acid in the earth does not affect adversely its use for any purpose for which bleaching earths are required. It may be employed in the decolorization of the finest kinds of food oils. It has been found that the small amount of acid which is present in the earth and which cannot be washed out of it, remains in the earth and does not contaminate the oil.

As far as the nature of the bleaching action of the earths is concerned, time is wanting to go into details. All that need be said is that there are a great many different explanations of the mechanism of the reactions. The bleaching action has been ascribed to adsorption phenomena. Colloidal action has also been advanced as a theory, as well as surface action or electrochemical action. Finally chemical action has been assigned as the underlying factor in the decolorization of oils. Each of these theories has its proponents and there appears to be some truth in all of them. To those who are interested, the suggestion is made that they read the article published in Petroleum Zeitschrift, 1926, pages 174 ff. There they will find described in detail the chemical theory of the decolorization of oils.

Dubbs Unit Ordered For Foreign Service

Chicago, Ill.—Orders recently received by the Universal Products Company will place several more Dubbs cracking units in operation in foreign countries.

The De Bataafsche Petroleum Maatschappij Nalik Pan, Borneo, D. E. I., has ordered four additional units. These will be added to two Dubbs units already in operation and four others under construction.

Also the Curacaosche Petroleum Industrie Maatschaappij, Curacao, D. W. I., who now have two Dubbs cracking units in operation, have ordered two more for immediate construction, making a total of four.

The Steaua Roman Company recently ordered two 1000-barrel Dubbs cracking units for immediate installation in their refinery at Bucharest, Roumania.

The Burmah Oil Company, Ltd., London, England, have ordered one 1000-barrel Dubbs cracking unit for immediate installation in their refinery at Rangood, India.

The Anglo-Persian Oil Company, Ltd., London, England, have also ordered one 1000-barrel Dubbs cracking unit for their refinery at Llandarcy, Wales.

450 B.C.

Herodotus, philosophic historian of the ancient Greeks, tells us of the use of asphaltum in the building of Babylon.

Brick walls were built with the aid of asphaltum as a binder. This asphaltum was carried on the backs of slaves from the river "Is," tributary of the Euphrates, indicating that even in the day of the ancients seepages of petroleum were not unknown.

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Refining Oil With Caustic Lye and Sulphuric Acid

By Ismar Ginsberg

During the past few years there have been quite a few innovations in the technology of oil refining. New processes and refining agents have been proposed, such as treatment with sulphurous acid, silica gel and other substances but without any disparagement of these new developments, all of which have their importance, it still remains a fact that by far the largest portion of the crude oil refined today, is treated with caustic lye and sulphuric acid.

It may be well just to review the conditions that have worked against the greater use of these new processes. In the first place there has been the item of increased cost of the process in comparison with the old, even if the results secured have been better. Then again the item of first cost of a new plant has militated against the new processes. There has also been the technical disadvantage that the new processes have been suited only for certain kinds of petroleum, while the old sulphuric acid-caustic soda process is applicable to all kinds of crude oils. The apparatus used in the old process is easily procurable in all refineries. Certain special kinds of oil, such as transformer and switch oils and turbine oils can be made only by means of the sulphuric acid-caustic soda process. Thus, in spite of the important disadvantages of this process in that the sulphuric acid converts valuable oil hydrocarbons into comparatively valueless acid resins, the sulphuric acid process is still preferred as a general rule in most oil refineries.

It is for this reason that it has been thought advisable to review shortly the important fundamentals on which this process is based and also study the new developments that have recently been made along these lines and especially with reference to the use of the bleaching earths and Fuller's earth which are now frequently employed along with sulphuric acid and caustic soda in the refining of oil. In this connection the writer wishes to acknowledge his indebtedness to an article on a similar subject published in Petroleum Zeitschrift, 1926, pages 751-6.

Treatment With Caustic Lye

As is known, crude oil can be treated with caustic soda lye either before the sulphuric acid treatment or after. When the oil is treated with the caustic lye before the acid treatment the naphthenic acids and phenols as well as the neutral sulphur containing and asphaltic substances are removed. In the after-treatment with caustic soda in addition to these substances ethyl sulphuric acid and sulphonic acids, which are formed during the sulphuric acid treatment, are also removed. For our purpose it is just as well to consider the preliminary and after-treatment with caustic soda as one and the same process.

When it is desired for one reason or another to recover the valuable naphthenic acids, as described by Burstin in Petroleum Zeitschrift, volume 17, page 1169, the caustic soda treatment is carried out before the sulphuric acid treatment. Another advantage of carrying out the caustic soda refining in this manner is that the washing of the treated oil with water is much easier process after final treatment with sulphuric acid than otherwise. However it is more general to treat the oil first with sulphuric acid and then with a solution of sodium hydroxide. For the acid is cheaper than the alkali and the acid destroys a part of the substances that would be removed by the alkali with resulting greater consumption of the more valuable reagent.

The action of the caustic soda on the impurities of the oil has been mentioned above. In studying the mechanism of the process, it is seen that the lye first reacts with the acid ingredients of the oil, and then the soap, which is formed in this manner, absorbs neutral substances. If the reader is interested in this phase of caustic soda action on oil, he will find an interesting discussion of the action of lye on lignite coal tar oils in Braunkohle, 1906, page 517 and 1907, number 17.

Soap Solutions

It has been determined that there is an optimum concentrated of sodium hydroxide which will form a soap that will absorb a minimum of the neutral oils and in the case of the lignite tar oils this is about ten per cent. It has also been found that the same condition holds good in the case of mineral oils. Thus Gurwitsch in Braunkohle, 1906, page 316, says that the dissolving power of alkaline naphthenic acid soap solutions for hydrocarbons is greater the higher the hydrocarbons are in the series. It is recommended that in the purification of kerosene the strength of the sodium hydroxide be not too great.

Advantage has been taken of the dissolving power of the soap solutions for certain undesirable ingredients of the oil in order to remove them and thus refine the product. United States patents Nos. 1,438,764; 1,438,985; 1,439,171 and 1,526,562 as well as German patents Nos. 403,134 and 403,135 and French patent No. 581,469 are concerned with processes in which use is made of the soap solutions for this purpose. In United States patent No. 1,496,399 there is described a process for the treatment of mineral oils with aqueous solutions of sulphonic acids without the danger of forming emulsions.

It is a fact that the greatest difficulty that arises in the technical refining of mineral oils by the use of sodium hydroxide solutions is the formation of emulsions. There are two main causes for the formation of these emulsions. In the first place they may be due to the mechanical movement of the emulsion ingredients, and in the second place they may arise from partial solution. The strongest emulsion effect is found when the concentration of the sodium hydroxide solutions is moderate and not great enough for a slating-out action. When the alkali solutions are concentrated, the particles of the soap do not enter the lye, and in the case of very dilute lyes no emulsions are formed. The surface tension between oil and lye increases with the temperature and decreases with the concentration of the caustic lye within certain limits. Hence it follows that low temperatures and average concentrations of sodium hydroxide are particularly well suited for the formation of emulsions. Then again when the mixture of oil and caustic soda is stirred too vigorously, there is a decided tendency for the formation of emulsions, and particularly at the beginning of the process it is wise to stir the mixture only moderately. When viscous oils are being mixed, it is advisable to take samples continuously so as to be sure not to miss the moment at which flocculation takes place. At this point it is well to add hot water which has the effect of increasing the settling of the flocculent mass which consists of the sodium salts of sulphonic acids and other organic sulphur compounds.

The behavior of emulsions has been studied, as it is a subject which is fraught with great interest to the refiner. It may be said that there is scarcely a matter in which he is more concerned in his daily work in the refinery than the formation and destruction of emulsions. Emulsions of the character discussed above generally separate out into three layers on standing. First there is the oil layer which is found on top, and then there is the lye layer which is found at the bottom. In between there is an opalescent layer which appears to be a very thick emulsion of oil in lye. It is understandable that at the limiting surface between the

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oil and the lye the concentration of soap is considerable and this leads to the formation of a soap skin which has the effect of preventing the flowing together of the mass.

Destroying Emulsions

The emulsions that are formed between oil and lye can be destroyed by means of acid, and when this is done, naphthenic acids are again liberated. A good agent for destroying the emulsion is alcohol, whose action appears to be the removal of the colloidal condition of the naphthenic acid soaps in water which is particularly favorable to the formation of emulsions.

It has been said above that the formation of emulsions is a difficulty which the oil technoligist has to overcome in the purification of oils with the aid of caustic soda lyes. There is however, still another difficulty and this is the hydrolysis of the soaps. As the soap hydrolyzes, the oil absorbs more and more acid soap, which is of course a very bad condition. When a large excess of alkali is employed it has been found that the hydrolysis of the soap is materially reduced. However it may be questionable that this is the most economic procedure, and it has accordingly been recommended that a small excess of soda be employed and that the acid soaps contained in the oil then be neutralized and washed out with the aid of a solution of sodium hydroxide. Studies made on the hydrolysis of these soaps have clearly shown that hydrolysis decreases as the concentration of lye decreases but rises with the temperature. The addition of alcohol has the effect both of reducing the emulsifying properties of the oil as well as preventing the hydrolysis of the soap. Thus an addition of from 0.25 to 0.3 per cent of alcohol materially reduces the tendency of the oil to form emulsions. In United States Patent No. 1,534,376 there is described a process for causting the settling of the alkali by quickly heating the mixture and then adding certain decolorizing agents, such as charcoal, Fuller's earth and the like.

Many of the new processes and innovations that have been disclosed during the past few years have been concerned with the prevention of the formation of emulsions. Thus there may be mentioned the process in which emulsions which are formed by washing the acidified oils with water are destroyed by means of formaldehyde. (See Dutch Patent No. 5953.) Another process consists of the use of an aqueous solution of acetone or alcohol for treating the oils prior to treatment with lyes to remove the sulphonic acids and thus avoid emulsification (See German Patent No. 312,136). British Patent No. 231,900 tells of a process for preventing emulsions in after-lye by using the lyes in the absorbed form in Fuller's earth, kielselguhr and the like. Another method consists in heating the oil above the boiling point of water, (See German Patent No. 360,274.)

Alkali Treatments

A number of improvements have also been made in the refining field proper. One special process consists in the artificial tarring of easily oxidizable ingredients and then refining. The same effect can be obtained by stirring the oil in the presence of air, as well as with ozone.

Various processes have also been devised for the alkaline refining of tars and tar oils, which consists in the treatment of the products with alkali at the proper temperature. A mixture of caustic soda and water glass (German Patent No. 354,395). It has also been recommended that part if not all of the caustic soda be replaced by lime and lime hydrate. However it is generally found that complete removal of the acid ingredients is not possible with this reagent.

Lead oxide is added to the caustic soda in the treatment of sulphur-containing hydrocarbons. The sulphur combines with the lead salt to form lead sulphide. In many oils it has been found advisable to add sulphur (see Petroleum Zeitschrift, 1925, page 880) for the purpose of removing the excess lead which is dissolved in the oil. However it has also been held that this is unnecessary, as the lead is merely held in mechanical suspension by the oil and will settle naturally. The addition of flowers of sulphur however has the effect of accelerating the settling of the lead to a certain extent When Mexican oils are treated, it is immaterial whether sulphur is added or not.

Further information on this subject is given in Chemical and Metallurgical Engineering, volume 29, pages 53-54, a process being described therein in which litharge and caustic soda, with the addition of sulphur, are employed in the treatment of sulphur-containing oils. The use of sodium plumbite for this purpose is described in British Patent No. 214,733.

Considerable work has also been done on the action of more or less strongly alkaline hypochlorite solutions on sulphur-containing oils. But not all of the sulphur is removed by this treatment. United States Patent No. 1,528,398 and British Patent No. 231,974 describe processes in which this chemical is employed.

Amongst other refining processes may be mentioned the one described in French Patent No. 560,447 in which the oils are distilled or heated with metallic soaps resulting in very effective desulphurization of the oil. The Frasch process is also important in this connection and can be successfully used on many different oils but is little suited to Mexican oil. A mixture of metallic oxides, such as cuprous oxide, iron sesquioxide and lead oxide, are used in this process.

New Process Company Is Host to Visitors

Fullerton, Cal.—On completion of its $50,000 addition to the Fullerton plant, the New Process Manufacturing Company acted as host to 1000 interested visitors. The building, which is of steel construction throughout, occupies an area of 100 by 180 feet.

Though only three years old, the growth of the company has been little short of remarkable, and as result of concentrated sales efforts, it is making regular shipments of Newton absorption equipment to many of the oil producing areas of the western hemisphere.

Officers of the company are D. L. Newton, president; Waldo O'Kelly, vice-president and treasurer; A. A. McCormick, secretary; W. J. Carmichael, general manager, and J. E. Kobernik, general superintendent. Products of the Newtown Process Manufacturing Company are marketed through all stores of the National Supply Company and Hurley Brothers, Tulsa, Okla., and the National Supply Corporation of New York and London is the foreign distributor.

New Offices Opened

The Pittsburgh Steel Products Company has opened offices in Houston and Tulsa. The Houston office is in the Second National Bank Building and the Tulsa office is in the Atlas Life Building. Both are under direction of J. R. Edwards.

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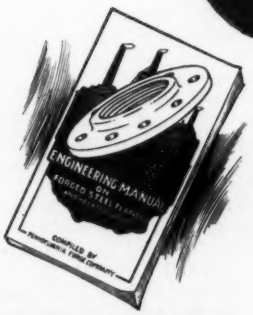

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Types of Buildings for Housing Refinery Equipment

(Continued from page 35)

walls, or exposed to cold, as in press vaults, or subject to severe wear, and attrition, with floors likely to be oil soaked, etc. It is therefore obvious that the greatest care should be exercised in construction, and particularly in reinforced design. Computations should be checked with the minutest detail, and the design should show clearly the size and position of reinforcement.

"While there are available for construction purposes, Portland, natural, and Puzzolan or slag cements, only the first-named should be used where subject to shock, vibrations, or stresses other than direct compression. Natural cement may be used in heavy foundations, where weight rather than strength is the essential feature, but neither this grade nor slag cement is recommended for general refinery service. Portland cement should meet the specifications of the American Society for Testing Materials.

"A table of recommended mixtures and maximum aggregate sizes for refinery construction follows:

	Recommended maximum size of aggregate in inches
1:1:1 Mixture for:	
The wearing course of two-course floors subject to heavy trucking and handling of barrels, such as occurs in cooperage building, grease plant, shipping building, and loading platform	½
1:2:3 Mixture for:	
Reinforced concrete roof slabs	1
One-course concrete road	3
One-course walks	1½
One-course concrete floors	1½
Sills and lintels without mortar surface	¾
Concrete draws	1
Reinforced concrete columns	1
Construction subjected to water pressure, such as traps, separators, cooling ponds, storage tanks, etc	1
1:2:4 Mixture for:	
Reinforced concrete walls, floors, beams, columns, and other concrete members designed in combination with steel reinforcing	1
Foundations for engines, pumps, rams, motors, etc., causing heavy loading impact and vibration	3
Concrete work in general subject to vibration	1½
Reinforced concrete sewer pipe	½
1:2½:4 Mixture for:	
Fuller's earth bins, and similar structures	1½
Building walls above foundation, when stucco finish will not be applied	1½
Walls of pits or basements, exposed to moisture	1½
Base of two-course road	3
1:2½:5 Mixture for:	
Walls above ground which are to have stucco finish	1½
Condenser supports, and wing walls, culverts, dams, small retaining walls	2
Basement walls and foundations where water-tightness is not essential	2
Foundations for small engines, pumps, motors, etc.	2
1:3:6 Mixture for:	
Mass concrete; large retaining walls, such as still foundations, footings, etc.	3
1:1½ Mixture for:	
Inside finish of tanks, and bin walls, where required, and for facing walls below ground when necessary to afford additional protection against the entrance of moisture. (To pass through No. 8 screen.)	
Back plastering of gravity retaining walls. (To pass through No. 8 screen.)	
1:2 Mixture for:	
Facing blocks and similar concrete products	½
Wearing course of two-course walks, floors, subjected only to light loads	¼
1:2½ Mixture for:	
Scratch coat of exterior plaster (cement and stucco.) (To pass through No. 8 screen.)	
1:3 Mixture for:	
Intermediate and finish stucco coats. (To pass through No. 8 screen.)	
Concrete block when coarse aggregate is not used	¼
Concrete brick	¼
Concrete drain-tile and pipe when coarse aggregate is not used	¼

The design of reinforced concrete structures—such structures representing a very common type of refinery housing—is not considered as being within the scope of this article other than to make mention of it. Such designing requires a mathematical analysis of the working stresses, bending movements, etc., and involves many detailed computations.

What has been mentioned up to this point in the present article has related mainly to a discussion of refinery buildings *in a general way*. The remainder of this article will be devoted to discussing the type of building and housing in use at one particular refinery—namely, the Parco, Wyoming, refinery of Producers and Refiners Corporation, which refinery was designed and built, for the most part, by the J. G. White Engineering Corporation, 43 Exchange Place, New York, N. Y.

The refinery at Parco, Wyoming, was designed to run 10,000 barrels of crude oil and to crack 5,000 barrels of residuum per day, producing gasoline, kerosene, and other distillates, as well as fuel oil and all grades of lubricating oil. A thorough study was made by the designers to determine a suitable type of building capable of adapting itself to the varying requirements of this type of plant as to size and shape. Without sacrificing utility, it was found that similar architectural treatment in brick with deep reveals, stone trimmings and steel sash, could be used for each building. Most of the buildings throughout the plant are of fireproof construction with concrete floors, metal skylights and window frames, gypsum roofs, and possess that architectural harmony that is so often lacking in refinery buildings.

Those buildings at the Parco refinery that are of the brick structure described above are as follows:

1. Power and boiler house.
2. Transfer pump house.
3. Crude still receiving houses.
4. Continuous light oil treating plant building.
5. Laboratory and office building, which is a wing of
6. Compounding and barrel house.
7. Contact-filtering plant.
8. Sharples dewaxing plant.
9. Foamite pump house.
10. Time-keepers and clock-punching building.
11. Combined tool-room and change house building.

Other structures made of various building materials at the Parco refinery are as follows:

1. Blacksmith, welding and machine shop building.
2. Carpenter shop.
3. Paint shop.
4. Electrical shop.
5. Receiving house for pressure stills, and pressure equipment housing.
6. Warehouse.
7. Experimental "shack," and a number of other miscellaneous buildings of lesser importance.

Most of the above buildings will be commented upon in additional detail in the paragraphs following, although not necessarily in the sequence given above.

Receiving House for Pressure Stills and Pressure Equipment Housing

Five double units of Dubbs stills are in operation at the Parco refinery—a common receiving house serving all units.

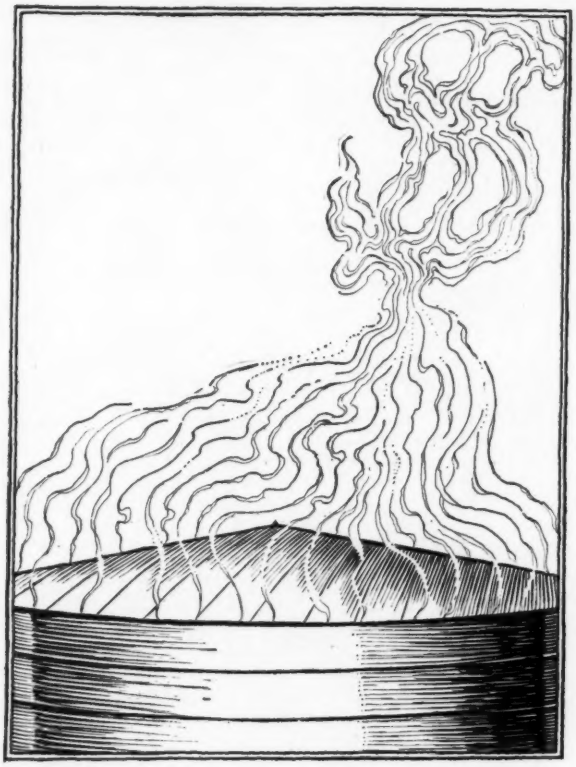
Since the essential features of a Dubbs unit include heating tubes built in a furnace, an expansion chamber, a dephlegmator, and a receiving house—housing for each of these will be discussed under separate headings.

Furnaces

1. *Foundations.*—The foundation for the furnaces and outer walls of the flues are constructed of concrete, properly reinforced where necessary to care for temperature and tensile stresses.

The concrete for this was mixed in the proportion of one part good quality Portland cement, two and one-half parts clean, dry sand, and one part of gravel having

Breathing costs money



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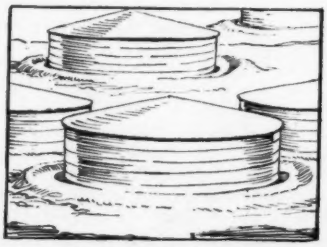

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aggregate that would pass through a 1½" ring.

2. *Brickwork.*—All surfaces of the combustion and tube chambers that are exposed to high temperatures are laid in first quality fire brick, dipped in mortar of high temperature cement. Furthermore, all such surfaces were given a coat of high temperature cement after being laid.

The exposed surfaces of brick work in the lower portion of the tube chamber and in the smoke flue are laid of second quality fire brick, dipped in mortar of good grade fire clay.

The outside walls of the furnace are constructed of a 9 inch course of fire brick, 8 inches of hard burnt, hollow building tile, 4½-inches of Sil-O-Cel insulating brick, and faced with good quality red brick laid with lime and cement mortar. These courses are thoroughly bonded together at frequent intervals.

The inner walls are constructed entirely of fire brick, 27 inches thick between combustion chambers (5 double furnaces were constructed to serve the 10 units) and 13½ inches between combustion and tube chambers. The batter of walls is ¾-inch per foot.

The floors of the combustion chambers were paved with 4½-inch fire brick laid upon 8 inches hard burnt, hollow building tile and 2½ inches of Sil-O-Cel insulating brick.

The roofs of the furnaces are constructed of successive layers of hard burnt, hollow building tile, Sil-O-Cel insulating brick, and good quality red brick. The roof over each of the combustion and tube chambers is supported by 9-inch first quality fire brick arches.

Expansion Chamber

1. *Housing and Insulation.*—Each expansion chamber is encased in a housing constructed of 3/16-inch steel plates substantially reinforced with angle iron stiffeners. Each chamber is heavily insulated from heat loss by filling the space between it and the housing, approximately 9¼ inches, with Sil-O-Cel insulating powder.

2. *Support.*—Each chamber is supported on a cast steel base ring which is bolted to a reinforced concrete supporting structure, 8 feet high by 12 feet 9 inches square, the chamber being thoroughly reinforced with steel bars.

The concrete for the above support was mixed in the proportion of one part good quality Portland cement, two parts clean dry sand, and four parts of clean gravel having an aggregate that would pass through a 1½-inch ring. The foundation for this structure was of similar material, but of a 1-2½-5 mixture.

Dephlegmator

Housing.—Each dephlegmator is encased in a steel housing and insulated with suitable sectional covering securely bolted to the inside of the housing. An air space is provided between the dephlegmator shell and the insulation with openings at the top and bottom provided with shutters for controlling ventilation as may be required in operation.

The two lower bays of the steel towers (upon each of which rests two dephlegmators) are encased with concrete fireproofing. The foundation of the tower is of concrete, that was mixed in the proportions of one part best quality Portland cement, two and one half parts of clean, dry sand and five parts of clean gravel having aggregate that would pass through a 1½-inch ring.

Receiving House

The receiving house is of steel frame construction with walls and roof of reinforced concrete, the steel beams being fireproofed with concrete. The building, 20 feet by 140 feet, houses all the pumps, control apparatus and instrument boards of the entire battery.

All concrete *above* the receiving house foundation was mixed in the proportions of one part good quality Portland cement, two parts clean, dry sand and four parts of clean gravel having aggregate that would pass through a 1½-inch ring. The concrete for the foundation was mixed in the proportion of 1:2½:5. The concrete floor finish was mixed in the proportion of one part cement to 1 part clean, dry sand and troweled smooth.

All windows of the receiving house are of rolled steel section type and are provided with ventilators where necessary. Operating mechanism for the ventilators is of the standard push bar type.

All doors are of rolled steel section type, glazed at the top and having metal panels in the lower portions. The hinges are of substantial design and all doors are provided with suitable locks of standard make.

All the windows and doors are glazed with ¼-inch rough wire glass, except in a few instances where clear glass was specified.

Power and Boiler House

The power and boiler house at the Parco refinery are combined in one building—the power house section forming one wing of the building, the whole being a brick structure with stone trimmings and steel sash. The structural steel for the building conforms to the standard specifications of the American Society for Testing Materials. A concrete floor—6 inches in thickness—serves as a foundation for the boilers and turbines. A 5-ply tar and gravel roofing is placed upon the gypsum roof slabs which go to make up the roof of the building. A vitrified tile coping surrounds the entire roof of the building. All window sash is of steel, and all glazing is rough wire glass. White cement mortar was used in laying the bricks.

Continuous Light Oil Treating Plant Building

The continuous light oil treating plant building is a one-story brick building 30 feet wide by 81 feet long by 14 feet 7 inches high that houses the pumps and manifolds of the continuous treating plant. It is of similar design to the power and boiler house building described above. The concrete used in roof slabs, coping, sills, etc., and that used in fire-proofing the steel beams was of a 1:2:4 mix, while the gravel used therein was of such size as to pass through a 1-inch ring. The steel reinforcement was of the deformed round bar type conforming to the specifications of A. S. T. M. Billet Steel construction reinforcement, structural grade. Windows with steel sashes were installed, while the glazing was ¼-inch ribbed wire glass. A 2-inch diameter ventilator in the roof of the building provides adequate ventilation.

Crude Still Receiving Houses

Two crude still receiving houses are in use at the Parco refinery—one "tail-house" each being used for the two batteries of crude stills. One receiving house was built by the Engineering Department of Producers and Refiners Corporation, the other, by the J. G. White Engineering Corporation. Both, however, are of brick structure.

The receiving house built by the White Corporation is 20 feet wide by 40 feet long by 23 feet high. Tin-clad doors are used throughout. The concrete used in the roof slabs, lower 4½ inches of second floor slab, coping and sills, etc., and in fireproofing all beams was a 1:2:4 mix, while the gravel used was not larger than 1 inch. The concrete used on and under the ground floor was a 1:3:5 mix, while the maximum size of the gravel used was 1½-inch. The concrete used in applying the 1½-inch finishing coatings on the ground and second floors of the building was a 1:3 mix. A 2-foot 6-inch diameter ventilator in the roof provides for the ventilation of the building. In other respects the design is similar to those buildings previously described.

Transfer Pump House and Air Compressor Room

The loading and transfer pumps with connecting manifolds and the air compressors and air receivers are located in one building—the pump house section being separated from the compressor room by a brick wall, but with a connecting door-way between the two. This building is of steel frame with brick walls and with corrugated galvanized iron roofing.

Foamite Pumphouse

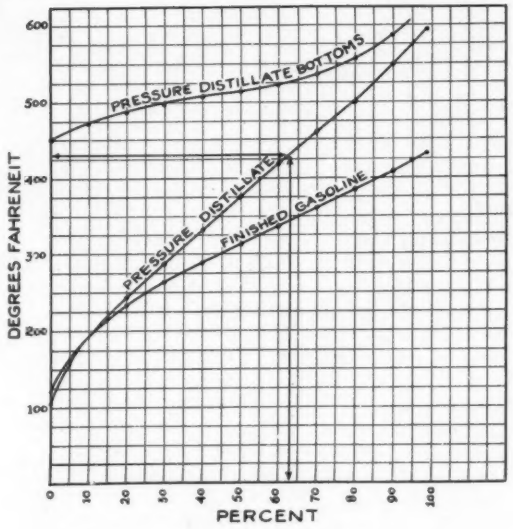
The building housing the foamite pumps and related equipment at the Parco refinery is 16 feet wide by 29 feet long by 12½ feet high. It is of steel frame with brick walls and a concrete roof. All concrete surfaces in contact with the ground were thoroughly coated with an approved coating for protection against alkali. All concrete used was a 1:2:4 mix. Kalamein doors are used in this building.

Contact Filtering Plant

The building housing the contact filtering equipment is one of steel frame, with brick walls and gypsum roof. It is 50 feet wide by 84 feet long. The concrete used in the wall and column footings was a 1:2½:5 mix; that used in the platform slabs was a 1:2:4 mix. Round deformed bars were used as reinforcing steel.

The roof is of gypsum roofing tile, all joints having been properly closed with gypsum cement. Red brick was used throughout, the bricks being laid up in White Portland cement mortar, with

How Much Gasoline Is in Your Pressure Distillate Bottoms?



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Gravity	49.6°Be.	54.8	34.4		50.0	56.4
I. B. P.	104°F	120°F	450°F		82°F	120°F
10	190	191	474		174	178
20	243	233	486		228	214
30	287	265	496		282	243
40	330	290	505		316	262
50	376	313	514		380	298
60	420	337	523		414	328
70	460	362	538	Cut 66.0%	430	356
80	498	384	556			380
90	548	406	588			406
EP	596	431	612			442
Percent. Yield	68.0%					66.0%

This is another example of what Winkler and Koch bubble towers are doing in actual service. Throughout the oil industry these towers are demonstrating their efficiency and operability on crude stills, pipe stills, cracking plants, rerun stills, and natural gasoline plants.

The refiner who does not secure results comparable to these is losing potential profits which are far more than he realizes.

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weather struck joints, about 5 courses to 13 inches. The window sash is of the standard center-pivoted side wall type of steel sash. In other architectural details the building is similar to buildings previously described.

Sharples Dewaxing Plant

From the standpoint of design and type of building materials used therein the building housing the equipment for the centrifugal removal of wax from oils is the same as that of the contact filtering plant building.

Combined Laboratory and Office Building and Compounding and Barrel House

The remarks made in the preceding paragraph concerning the building in which the Sharples equipment is housed are also true of the combined laboratory and office building and compounding and barrel house.

Change House and Tool Room

This, also, is of similar architectural design to the buildings previously described—namely—steel frame, brick walls, and, in this particular case, concrete roof.

Construction Materials Used in Other Buildings at Producers and Refiner Corporation's Parco Refinery

Nearly all other buildings at the Parco refinery, including the housing for the natural gasoline plant equipment, are of corrugated galvanized iron walls and roof, and either with a wooden or a steel frame. This does not give a fireproof type of building, but it is economical and is less hazardous than a wood building.

The warehouse and the fire station are the only important buildings of wood at this refinery, and both of these are located outside the refinnery fence where danger of fire is reduced to a minimum.

Sweater House

Paraffin wax is not made at the Parco refinery, hence it is interesting to note what Bacon and Hamor ["American Petroleum Industry," Vol. 2, page 764, McGraw Hill Company, Inc., (1926)] have to say about the construction of a sweater house:

"The building in which sweaters are located, or, as it is sometimes called, the 'oven' is a necessary feature of a sweating system both as to location and construction. It should be a substantial building, either of brick or concrete, and should be so located that there will be free circulating of air on all sides. All doors and windows should be large, easily opened, and so constructed that, when closed, they will make the oven practically air-tight. This last feature is especially important, since any air leakage affects the evenness of the room temperature and makes steam costs unnecessarily high."

Acid-Recovery Pan Houses and Buildings in Contact With Acid Fumes

Acid-recovery pan houses and all buildings that are in the least subjected to the action of sulphuric acid fumes, as a general rule, are of wood coated with some protective coating of an acid-resisting nature. This is because almost all other types of building materials, whose use would be economically feasible—with the possible exception of brick—are attacked by the fumes of sulphuric acid.

Good Houses Get Good Care

(Continued from page 36.)

than will be needed later in the operation of the plant.

The Phillips Company builds a permanent house. This is contrary to the more common practice of building homes for plant workers from the portable types of houses.

The Phillips house is a four-room structure put on a solid foundation. It has lights, heat and sewer. The floors are edge grain pine. Walls and ceiling are plaster, which is papered. The painting is in color scheme used by the company for its own properties.

Rent Nominal

The rent charged for these houses is fixed through calculations that provide for taking care of depreciation.

Day to day care is left to the workman and his family. The vines and flowers growing about the houses at the Phillips plants are evidence of the pride taken in these homes. Instances of houses being abused are so rare they are negligible in the company.

Company care of the houses comes under maintenance of plant housing. When a plant is to painted, the houses are inspected to see if they need painting. This policy is followed in regard to paper. Equipment that may need repair at irregular intervals is cared for by the tenant, or by other members of the plant force. Plumbing, gas piping and electric wiring can be repaired by plant men accustomed to such work.

The houses have the fire protection of equipment kept at the plants.

By having a standard house of four rooms, this company is able to construct houses at a cost lower than individual building charges. The standard house allows lumber and other equipment to be bought for particular work, so there is scant waste. Then lumber, hardware and fixtures can be bought in bulk, gaining all advantages of low price from this angle. Construction and painting are under regular departments of the company's activity.

Caution in providing houses makes against over building in any district.

The housing plant of the Phillips Company is void of rules and regulations, which may be the reason it works.

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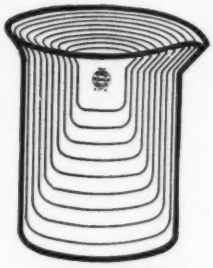

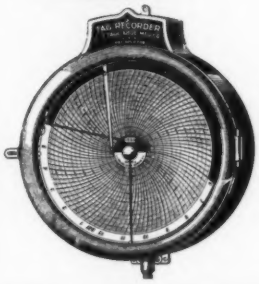

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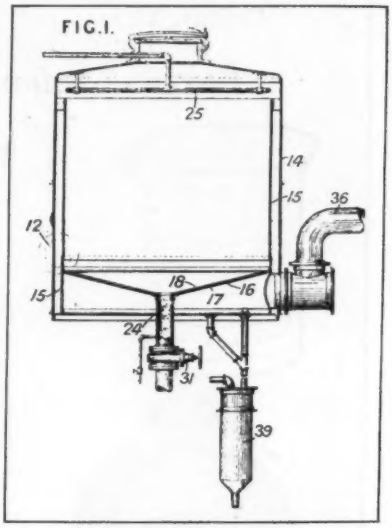
Continuous Oil Refining Process.— Crude petroleum or petroleum from which the lighter constituents have been removed is circulated rapidly through a vessel in which it is heated to a temperature approximating the boiling point of the highest boiling fractions to be distilled off. After this the oil enters the lower end of a column in which the escaping vapors are subjected to fractional condensation. French Patent No. 598,295.

Auto-Oxidation of Mineral Oils and Determination of Tar Value. — The acids which are produced in the sludge test of mineral oil have been examined. Those from a normal unrefined transformer oil (density 0.891, open flash point 154 degrees C., acid value nil, tar value 0.88, ash 0.015 per cent, viscosity at 20 degrees C. 3.09) had a greater density than unity. The copper salts were completely soluble in benzine.

Treatment with benzine caused a separation into sixty per cent of soluble, oily acids, and forty per cent of insoluble asphaltic acids. The soluble acids had acid value 66, saponification number 130, acetyl number 58, iodine number 16, mean molecular weight (Rast) 285. No reaction was given in the formolite test. The insoluble acids had acid value 67, saponification number 269, acetyl number 127, iodine number 18.

FIG. I.



It is concluded that the soluble acids consist of hydroxynaphthenic acids formed from saturated naphthenes and that the soluble acids are produced from unsaturated hydrocarbons by union of two molecules and the addition of oxygen. Of the acids from a refined white oil (density 0.842 at 20 degrees C., open flash point 181 degrees C., free acid nil, sulphur 0.015 per cent, tar value 14.5, viscosity at 20 degrees 3.98) ninety per cent were soluble in benzine and this fraction had a density of 1.014, acid value 121, saponification value 240, acetyl value 44, iodine number 16, mean molecular weight 357 and gave a negative formolite reaction.

The copper salts were soluble in benzine and the peroxide content was very slight, the amount of active oxygen present being 0.06 per cent. A modified sludge test is also described in which sodium hydroxide is employed as a catalyst resulting in a saving of time and oxygen. Fifty grams of the oil are mixed with ten grams of pumice saturated with sodium hydroxide. This reagent is prepared by the addition of the pumice to 0.7 gram of sodium hydroxide in ten cubic centimeters of water and drying at a temperature of 105 degrees C. The above mixture is made in a two hundred cubic centimeter conical flask and is then heated at a temperature of 120 degrees C. for period of 24 hours. The mixture is cooled, fifty cubic centimeters of a fifty per cent alcoholic sodium hydroxide (containing 7.5 per cent of NaOH) are added, and the liquid is heated under a reflux condenser for twenty minuts. The soap solution is separated, acidified, and extracted with benzene. From the extract, after removal of mineral acid by washing, the tarry

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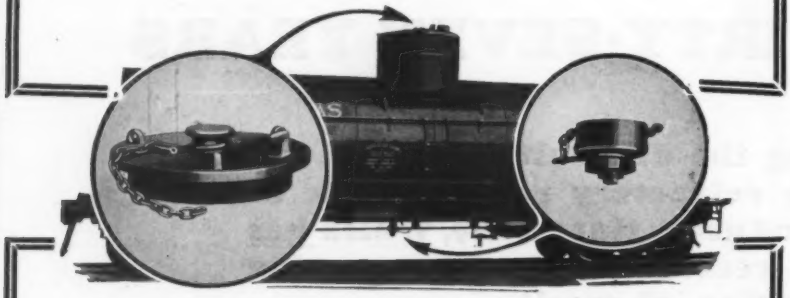

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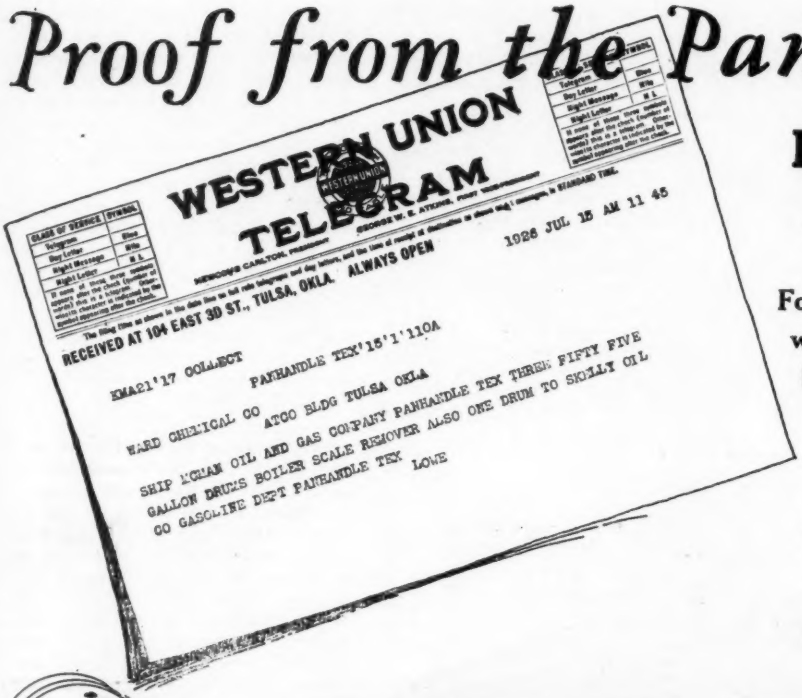
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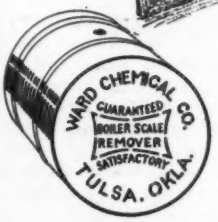

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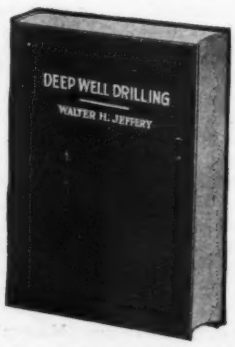

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matter is obtained by evaporation. This method with refined transformer oils gives results differing only a few hundredths of a per cent from those obtained by the standard German method. Chemiker Zeitung, 1926, volume 50, pages 263-4.

* * *

Distilling, Cracking and Purifying Mineral Oils.—In purifying hydrocarbon vapors by passage through a heated catalyst, such as Fuller's earth, bone black, bauxite, kieselguhr, infusorial or other absorbent earths, a solvent which may be a condensate from the process, is passed through the catalyst during the treatment to remove polymerized products. The catalyst is heated by passing the vapors around the vessel containing it, or by providing the vessel with a steam or heat insulating jacket.

Thus, the catalyst is supported in an inner vessel 15, shown in the accompanying figure, on a perforated floor formed of wire gauze 17 held between perforated and slotted plates 16 and 18. Hot vapors from an oil still enter by an inlet 12, preferably tangentially, the annular space between the vessel 15 and the outer vessel 14 and pass downwards through the catalyst to an outlet 36.

A solvent liquid is distributed over the catalyst from a perforated pipe 25. The liquid which collects in the base of the vessel 14 may be passed into the still through a pipe 24 or through a trap 39. The catalyst may be discharged through a gate valve 31. If the vapor is passed directly into the catalyst, sufficient condensate to serve as solvent for the polymerizerd products is formed therein. The vapor supply pipe may be fitted with a valve to maintain the still under pressure, and to allow expansion of the vapors into the catalyst to regulate the temperature.

Steam at temperatures up to 400 degrees F. may be admitted to the catalyst chamber. A cooling coil may be placed above the catalyst to condense part of the vapors to form a liquid which acts as a solvent. A liquid seal may be formed between the base of the catalyst chamber 15 and the outer Chamber 14. The vapors may pass upwards through the catalyst, which may be contained in a chamber mounted directly on the oil still. British Patent No. 249,871.

* * *

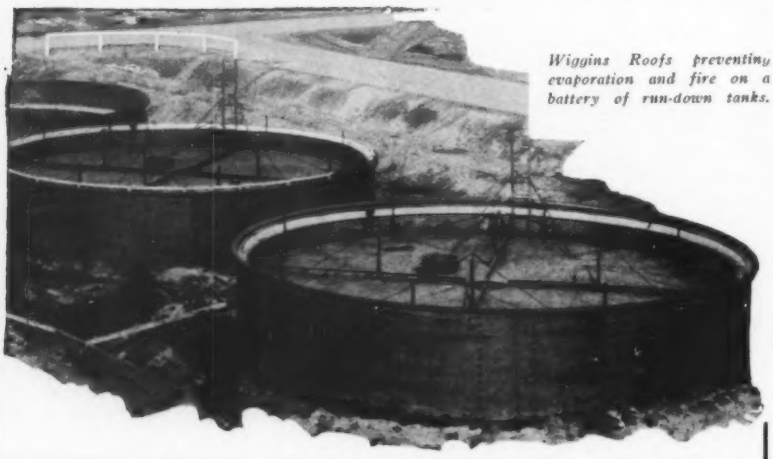
Fractionating Hydrocarbons. — German Patent No. 425,759 describes an apparatus used in the fractionation of hydrocarbon oils and the like. This apparatus is characterized by the connection that is made between the towers heated by (shown in the figure) means of heating coils B for the rising vapors A and the cooling tower C, cooled by the coils C, for repassage of the vapors and the collecting boxes E. The latter are extended under the towers and the catch the condensed oils that flow down the towers. The separating walls F in these containers E dip under the normal surface level of the liquid and hence act as a closure against the escape of the gases, without in any way impeding the flow of the condensate from one vessel to the other. The free space above the collecting vessels is so divided by means of a separating wall G dipping into the condensate that the vapors rising in one tower can go over into the next tower for rising vapors.

* * *

Simple Apparatus for Viscosity Determinations.—A simple apparatus for determining viscosities of crude oils and petroleum distillates is described in Le Petrole, 1925, page 496. This apparatus consists of a rotatable board or a plate to which a number of glass tubes are connected. These are filled with the oil that is to be tested, the tubes being filled to such an extent that there still is an empty space in them. Then when the tubes are rotated through an angle of 180 degrees, the air bubble will rise in the tubes at different rates depending on the viscosity of the various oils. In this manner the viscosity of one oil in comparison with another or with a standard oil can readily be determined with satisfactory accuracy. The apparatus is so simple that anyone can easily construct it in the laboratory.

* * *

Conversion of Heavy Mineral Oils Into Benzines.—Heavy mineral oils are converted into benzines in two phases. In the first place catalytic decomposition takes place at a temperature of 600 to 650 degrees C. and benzine and gases are obtained. After separation of the carbon in an expansion chamber the mixture is dephlegmated and the condensed oil is returned to the apparatus. The gases and vapors are then condensed, the benzine is separated and the gases are then col-



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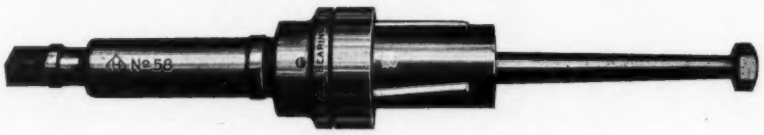

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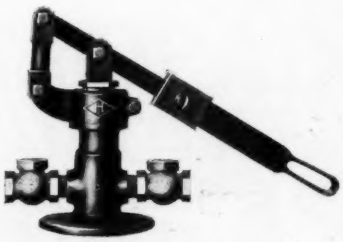

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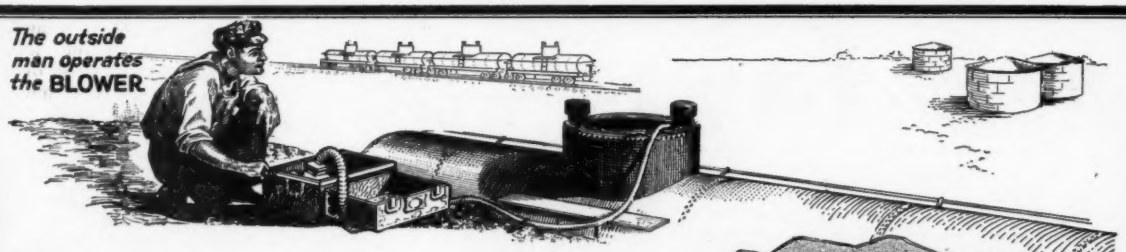

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lected for treatment in the second stage of the process.

These gases are next freed from their sulphur ingredients and then compressed in an apparatus in the presence of activated iron and nickel under a pressure of five atmospheres. As the pressure increases, the more volatile ingredients are removed through a safety valve. The remaining gases are compressed to fifty atmospheres and then temperature raised to 110 degrees C. After expansion in a cooling system the benzine is condensed. All condensates are collected and when mixed together yield a series of products which are similar to low gravity crude oils.

This process may be carried out on petroleum residuals, natural oils, bituminous shales and oils obtained from the distillation of lignite, peat and coal tar. The synthetic gasoline, made in this manner, contains sixty per cent of ingredients which have a boiling point lower than 200 degrees C. The gas which is recovered from the second stage of the process is employed in heating the original oil. Rass. Min. Met. Chim., volume 62, 12-14.

* * *

Reworking Used Oils.—Treatment of the used oils with bleaching earths is found sufficient for most purposes. The reworking of the oil is difficult only in the case of those products which have become strongly acidified, and also in the case of special oils. The lubricating oil or the insulating oil, which is recovered in this manner, is usually as fully usable as the oils which are obtained from crude petroleum. For the ingredients which are easiest oxidized and which are decomposed most readily during the use of the oils are entirely removed by this treatment. Zeits. Verein der Deutsche Ing., volume 70, pages 401-02.

* * *

Working Up Alkaline Waste Materials.—German Patent No. 426,947 is concerend with a process for obtaining products of technical value from the alkaline waste products that are recovered in the refining of mineral, tar and shale oils.

These waste products are first freed from their water content as far as possible and then distilled under a vacuum with superheated steam unit all the volatile ingredients have been removed. This refers specially to the non-sulphurized oils, and then the residue is decomposed with the aid of dilute acid. The distilled oils may be employed as lubricating oils while the product obtained from the residue in the form of an emulsion can be used in the place of soaps and Turkey red oil, and particularly for fat splitting purposes.

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Rio Grande Plant Built for Permanence

(Continued from page 32.)

details of the lines themselves are given, the location of all valves, the exact location of all tees, els, unions, for the maps are drawn to scale, the type of plugs, where used, is shown and the location of all plugged tees or line ends. The major map, of course, covers the refinery proper, and tanks in detail. Additional records in a series of small maps are kept, covering such items or departments, as the 40 car capacity loading rack, the power house, the agitator assembly, and the lube oil warehouse.

Such records as these constitute a very valuable adjunct to any refining plant. A brief study of the maps solves practically any problem of pumping, transfering or handling, and since any change, however small, in the plant yard is immediately changed on the map, there need never be any confusion as to what can or cannot be done on the yards of the refinery.

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This book describes the principles of company organization as regards scope, personnel, and methods. It was written to meet the urgent, immediate need on the part of many participating in the oil industry, especially the executives of oil companies, for a book on the business of oil and gas production. 264 pages, 6x9, 30 figures.

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Repair Procedure in Refineries

(Continued from Page 30)

dangerous without first switching off the circuit and screwing on the vapor-proof globe before turning the light on again.

One can not be too careful in protecting the men against high voltage. For instance, in a battery of electric dehydrators work very often must be done on the top of them. The operator should open the switch, hang a danger sign over it, write in his logbook when he has the treater clear and safe to work on. So, the man working on this unit has to mark on the log when he is through and sign it. A little misunderstanding here may cost a man his life. Main switches should be opened and danger signs hung on them before repairs are started on any motor-driven piece of machinery. Likewise, the throttles of turbines, engines, pumps or steam headers. If you are employed around any such work as just described make sure there are adequate safety measures in use. Boiler blow-down lines should be run separately to the pump, a fine bit of insurance against cooking the workman inside the drum.

On a properly managed refinery maintenance organization men are all taught the safe way to work; from using brass hammers around gasoline to the personal inspection of safety signs on valves before entering a boiler. Gas masks are always to be used where there is any doubt as to the possibility of asphyxiation and a guard should be placed over anyone entering a tank; even with a life belt and a rope attached. Periodic inspections should be made of all hand tools, and those in an unsafe condition either repaired or discarded. In some cases, at the Shell Company of California's Wilmington refinery, the signatures of three men who have made personal inspection of the work to be done, to determine the hazardousness before it is allowed to be undertaken by workmen are required.

From the fellow who insists on wearing a flowing necktie while running a drill press to the "sap" who starts a fire without a permit, runs a long line of "human elements" never to be forgotten if the day is not to be "utterly ruined" by or for someone, and there is but one solution to the problem.

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Quarters will be maintained at 215 Alexander Building. Edward Soph, who represents the Schutte & Koerting Company in Oklahoma, and C. K. Bennett, district manager, will be permanently located in that office.

The Schutte & Koerting Company produce a complete line of heat transmission equipment, vapor condensers, knock-out boxes, heaters and coolers. They also supply high pressure and high temperature valves, jet apparatus, and a complete line of power plant specialties.

The Schutte & Koerting Company is being represented in South Texas by the Ayers Engineering Company, 908 Post-Dispatch Building, Houston. This company maintains engineering service for the plants using Schutte & Koerting equipment.

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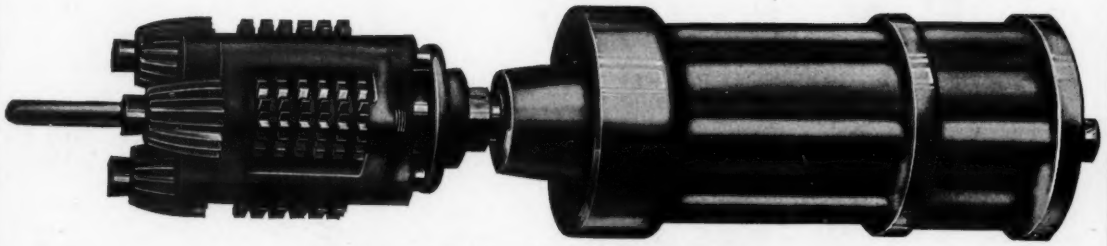

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RECENT REFINERY PATENTS

BY STAFF REPRESENTATIVE

Washington, D. C.—The following patents of interest to the refining industry have been granted by the United States Patent Office:

No. 1,588,836, granted June 15, to Joseph Hidy James, Pittsburgh, assignor to Clarence P. Byrnes, trustee, Sewickley, Pa., for a method of making intermediate oxidation products from hydrocarbons which are gaseous at normal temperatures and pressures, consisting of forming a mixture of said hydrocarbons and oxygen in the proportion of about one volume of gas to not over three and one-half volumes of air, and passing said mixture in contact with a solid catalyst at a temperature not exceeding 600 degrees C.

No. 1,588,861, granted June 15 to Jay P. Walker, Oklahoma City, assignor to American Tank Company, Oklahoma City, for an oil and gas separator consisting of a vertical tank, fluid inlets in the sides of the tank above its central portion, a jacket within the tank spaced from the walls and top thereof, means having baffling surfaces extending vertically and transversely to the flow of the influent for extracting oil therefrom and located in the space between the jacket and the inner walls of the tank and directly in the path of the influent, baffles in the jacket for separating the oil from the gas, a gas outlet, and an oil outlet.

No. 1,588,862, granted June 15 to Jay P. Walker, Oklahoma City, assignor to American Tank Company, Oklahoma City, for a hatch for oil tanks consisting of a collar for attachment to a storage receptacle, a cover pivoted on the collar, a sealing ear on the collar, an aligned sealing ear on the cover registering with the ear on the collar, and a ball pivoted on the collar, the sealing ears being located to arrest the ball in an upright position.

No. 1,588,863, granted June 15 to Jay P. Walker, Oklahoma City, assignor to American Tank Company, Oklahoma City, for an antifreeze fluid for heated storage tanks which consists in automatically cutting off the supply of liquid at a high level to create a vapor space in the tank conducting the vapors from said space by connecting the same through a regulator immersed in the heated liquid in the tank, and by relieving a vacuum in said tank through a regulator immersed in the heated liquid.

No. 1,589,023, granted June 15 to Walter Edwin Trent, Washington, D. C., for a process for manufacturing a carbonized solid fuel and converting low boiling point oils by heat generated at a single source, consisting in utilizing a portion of said heat for subjecting oils to cracking conditions of temperature and pressure, and in employing by-product heat for carbonizing comminuted fuels to produce a carbonized residue.

No. 1,589,374, granted June 22 to William F. Dietzsch, Chicago, for a process of separating light oils and tar from an emulsion of water, which consists in heating the mass of liquid to a temperature slightly above the boiling point of the light oils, but below the boiling point of water, drawing off the resultant vapors of light oils, causing the tar separated from the said light oils to gravitate to the bottom of the mass of liquir fuid, condensing the light oil vapors, and withdrawing the said tar from the bottom of the remaining mass of liquid.

No. 1,589,631, granted June 22 to Edward A. Dieterle, Glenn Ellyn, Ill., for an oil treating apparatus comprising a metallic shell provided at one end with a combustion chamber while the opposite end is provided with an outlet

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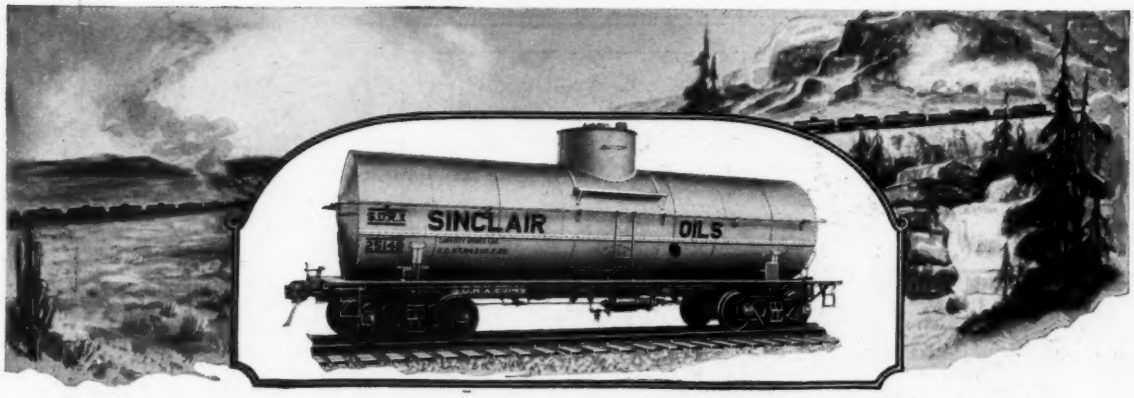

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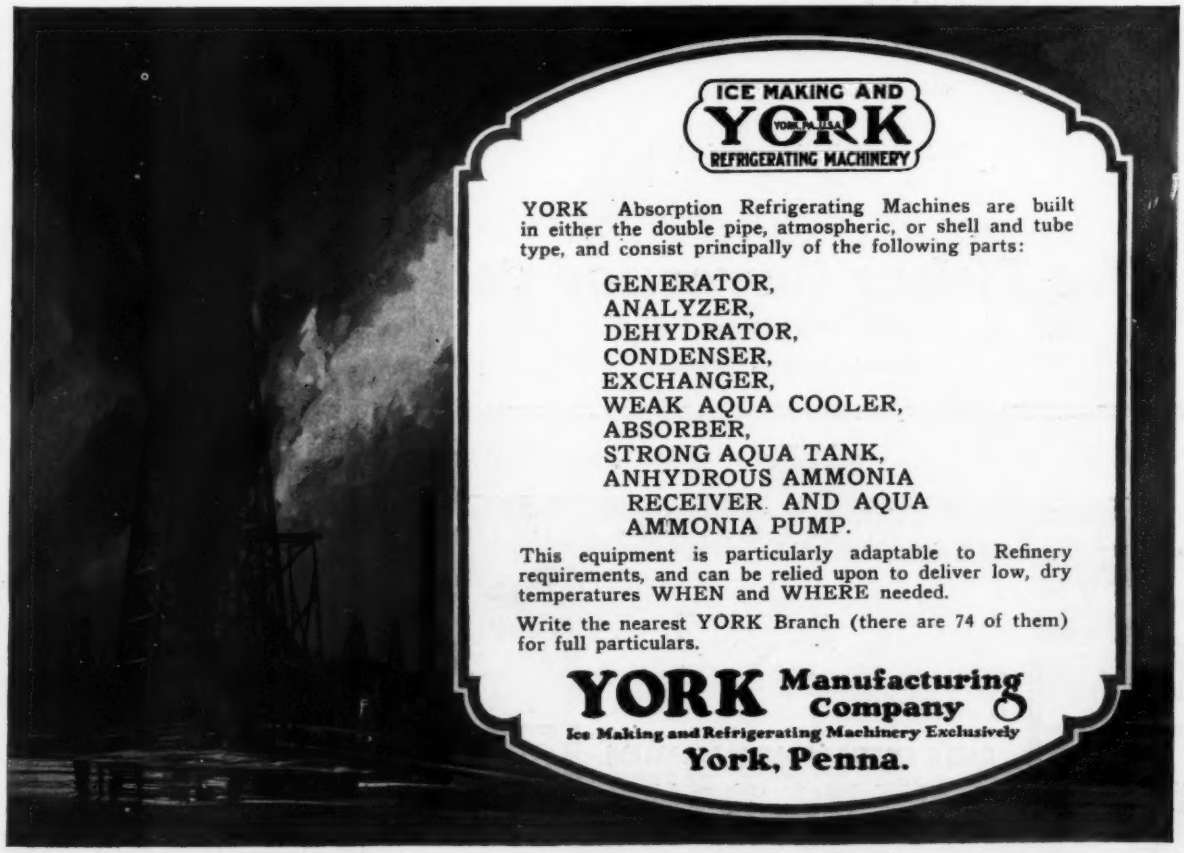

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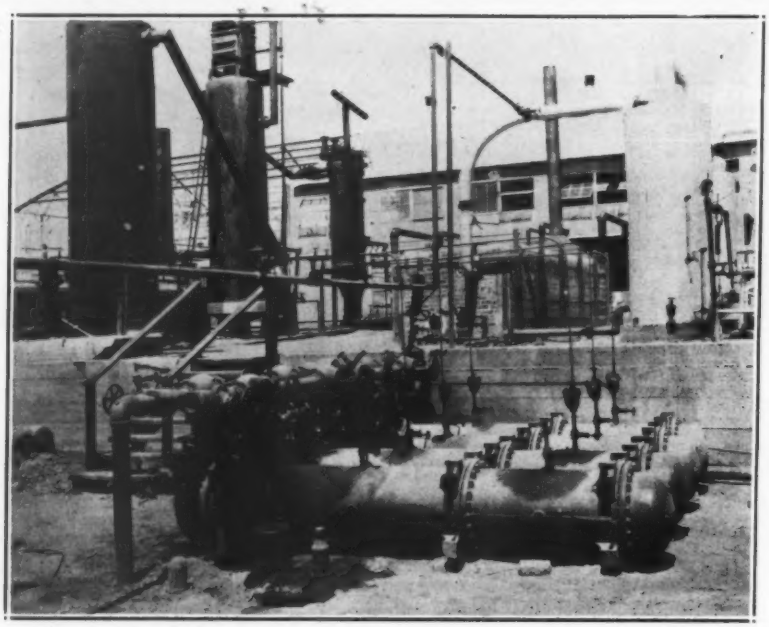

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stack, a plurality of metallic tubes or flues, bent back and forth in opposite directions, disposed intermediate of the combustion chamber and the outlet and in communication therewith, the flues being arranged in series, with the flues of one series arranged in staggered relation with the flues of the other, means communicating with a source of supply whereby oil may be sprayed onto the tubes, regulable means whereby the vaporized products may be conveyed from the shell and whereby pressure in the shell may be obtained, and means whereby the residual oils may be withdrawn from the lower end of the shell.

No. 1,589,908, granted June 22 to Perry J. Sweeny, Whiting, Ind., assignor to Standard Oil Company of Indiana, for a method of producing low boiling point hydrocarbon oils in the gasoline range of boiling point from higher boiling point hydrocarbon oils which comprises passing the higher boiling oil in continuous flow in a restricted stream through a heating zone in which it is brought to conversion temperature, discharging the heated oil from said stream into one of a plurality of series connected enlarged chambers through which the oil is caused to flow at a slower rate while conversion temperature is maintained therein, pressure being maintained upon the system, withdrawing liquid products of conversion from another of said enlarged chambers remote from the one into which the oil is caused to flow from the heating zone, continuing the flow of oil through the enlarged chambers until substantial coke and asphaltic depositions take place in the later ones of the series of enlarged chambers, and then changing the flow of oil from the heating zone to a chamber from which liquid products were previously withdrawn and withdrawing liquid products of conversion from a chamber into which oil was previously admitted from the heating zone, thereby reversing the flow of oil through the series of enlarged chambers.

No. 1,590,505, granted June 29 to Richard W. Hanna and William D. Mason, Richmond, Cal., assignors to Standard Oil Company of California, for an apparatus for determining the level of a liquid oil undergoing distillation in a vessel, comprising a plurality of temperature indicating or measuring means positioned within horizontally disposed U-shape tubes having both arms open into the vessel said U-tubes being disposed at vertically spaced aparat points along the vessel, the tubes being disposed sufficiently outside of the vessel to radiate heat so that when filled with oil cooling of the oil will cause the circulation of oil therethrough and when the upper end is filled with vapor the condensation of the vapor will cause a marked lowering in the resultant indicated temperature, thus positively indicating the level of the oil within the vessel.

No. 1,590,617, granted June 29 to Mel-

vin De Groote, St. Louis, assignor to Wm. S. Barnickel & Co., Webster Groves, Mo., for a process for treating petroleum emulsions, characterized by subjecting the emulsion to the action of a water insoluble salt of a mineral sulphonated oil.

No. 1,590,640, granted June 29 to Tsuguyoshi Mii, Yamaguchi-Ken, Japan, assignor to Kotara Isomura, Yamaguchi-Ken, Japan, for a process of producing a catalyst for the manufacture of oils having low boiling point, which consists in impregnating an aluminum hydrosilicate with a soluble chloride.

No. 1,590,841, granted June 29 to John Robert McConnell, Whittier, Cal., for a process of treating light hydrocarbons containing a sensitive discoloring compound to produce water-white light hydrocarbons substantially free from color and having a definite color stability, comprising exposing the light hydrocarbons for a period of time to the sole action of light rays to completely fix the color of the sensitive discoloring compound and thereafter distilling the so treated light hydrocarbons.

No. 1,590,870, granted June 29 to Charles F. Williams, Philadelphia, for an oil separating apparatus consisting of a separating tank, an inlet for admitting a fluid mixture thereto, means adjacent the inlet for separating a lighter from a heavier liquid in said mixture and deflecting the liquids in opposite directions, and independent means for withdrawing the two liquids from said tank.

No. 1,590,965, granted June 29 to Charles R. Downs, Cliffside, N. J., assignor to The Barrett Company of New Jersey, for a process of purification of hydrocarbons which comprises passing an impure aromatic hydrocarbon in the vapor phase and an oxygen containing gas into contact with a catalyst at a temperature between 250 degrees C. and 550 degrees C., the oxygen concentration of said gas being such that oxidation of the impurities takes place without substantial oxidation of the hydrocarbon.

No. 1,591,024, granted July 6 to Fred P. Dodge, Port Arthur, Texas, assignor to The Texas Company, New York, for an oil recovery apparatus comprising a vessel, means secured to the vessel for skimming floating oil from the surface of a body of water, means for conducting the recovered oil aboard the vessel, means for separating the oil from any water with which it may be mixed, a plurality of separate compartments for storing the oil, and means connecting the separating means and the several compartments for selectively delivering the oil from the separating means to any one or all of the storing compartments.

No. 1,591,428, granted July 6 to Chauncey Matlock, New York, assignor to Gasoline Corporation, New York, for a method of fractionating vapors of different boiling points, which comprises injecting a spray of cooling liquid into a moving stream of said vapors, and diverting a mixture of condensed particles and vapors from said stream in a direction different from the general direction of movement of said vapors; an apparatus for so treating hydrocarbon oils consisting of a furnace, a number of treating pipes in said furnace, means for supplying fluids to said pipes, a header connected to the outlet ends of said pipes, a means for injecting liquid into said header, and means for fractionating the vapors thus cooled.

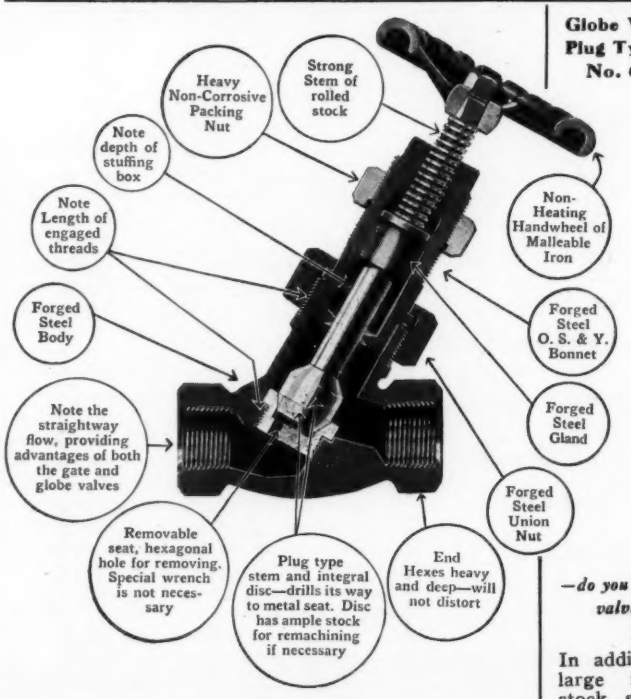
No. 1,591,728, granted July 6 to Walter Edwin Trent, Washington, D. C., assignor to Trent Process Corporation, Washington, for a process of separating hydrocarbon oil from water and other impurities intimately associated therewith, comprising commingling said hydrocarbon with a comminuted carbonaceous mineral fuel to cause the oil and carbonaceous fuel to combine and form a substantially plastic amalgam rejecting water and impurities originally associated with the oil.

No. 1,591,735, granted July 6 to Joseph F. Beattie, Hurley, N. M., for a motor fuel comprising gasoline carrying a small percentage of paraffin wax in solution therein.

No. 1,591,744, granted July 6 to Roy Vross, Kansas City, Mo., for a method of dehydrating hydrocarbon oil which consists in intimately mixing it with bentonite and separating the treated oil from the bentonite.

No. 1,591,853, granted July 6 to Wil-

Edward Forged Steel Valves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Plug Type
No. 682
Heavy Non-Corrosive Packing Nut
Strong Stem of rolled stock
Note depth of stuffing box
Note Length of engaged threads
Non-Heating Handwheel of Malleable Iron
Forged Steel Body
Forged Steel O. S. & Y. Bonnet
Note the straightway flow, providing advantages of both the gate and globe valves
Forged Steel Gland
Forged Steel Union Nut
Removable seat, hexagonal hole for removing. Special wrench is not necessary
Plug type stem and integral disc—drills its way to metal seat. Disc has ample stock for remachining if necessary
End Hexes heavy and deep—will not distort

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Refinery and Gasoline
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Laboratory
Apparatus

Scientific
Instruments

Greene Brothers

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liam J. MacArthur, Los Angeles, Cal., assignor of one-half to Rea E. Maynard, for a method of separating oil from a mixture of oil and water which comprises establishing two independent surfaces sufficiently near to each other to form a capillary opening therebetween, establishing a capillary water film in said opening and thereafter submitting the oil and water mixture to the separating action of said capillary opening.

No. 1,591,984, granted July 13 to Erich Krause and Koloman Roka, Constance, Germany, assignors to Holzverkohlungs-Industrie Aktien-Gesellschaft, Constance, Hadenia, Germany, for a process for the chlorination of saturated hydrocarbons consisting in causing the said hydrocarbons to react with chlorine at temperatures of 300 degrees to 650 degrees C. in the presence of oxygen, the quantity of oxygen employed and the velocity of the gases being such that undesirable oxidation of the hydrocarbon is avoided.

No. 1,592,058, granted July 13 to James W. Weir, Fillmore, Cal., for a process of refining lubricating oil stocks which comprises treating relatively low viscosity lubricating oil stock with sulfuric acid until the action of the acid upon such stock is substantially complete, then without removing the produced sludge from said treatment introducing relatively high viscosity lubricating oil stock to the admixture and commingling the same therewith, whereby the added oil stock is reacted upon by the acid sludge resulting from the sulfuric acid treatment of the original stock.

No. 1,592,112, granted July 13 to Hippolyte Marcel Lamy-Torrilhon, Paris, France, for an apparatus for continuous refining, consisting of a distillation column subdivided into a number of elements, means for progressively heating these elements, a multiple effect apparatus having a series of multiple effects equal in number to number of elements of the said column, connections permitting the vapor produced in each multiple effect element to traverse an element of the column and then to pass into the following multiple effect element.

No. 1,592,179, granted July 13 to Nicholas Shouldice Clarke, New York, assignor to Athabasca Oil Products, Ltd., Edmonton, Alberta, Canada, for a process for separating oil from oil sands or the like consisting in heating the sands by subjecting them to the action of a mixture of superheated steam and a suitable gas, then mixing the resultant product with water and separately drawing off the oil and the solid material.

No. 1,592,214, granted July 13 to Ernest O. Linton, Hammond, Ind., assignor to Linton Gasoline Process Company, Chicago, for an oil cracking apparatus comprising a vaporizing chamber and means for heating the same, said chamber having therein extended inclined plates, means for delivering oil to and above said plates, and an exit pipe at its bottom; a vapor cracking retort constructed and arranged to provide for the vapors a shallow passage having heated walls, means for heating said retort, and a conduit of less diameter than the retort connecting the vaporizing chamber and the lower portion of said retort.

No. 1,592,324, granted July 13 to John

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Joseph Allinson, Bartlesville, Okla., assignor by mesne assignments to Doherty Research Company, New York, for a process of treating petroleum containing natural brines which comprises heating confined raw petroleum oil while in a rapidly moving stream by heating interchange with hot oil residuum, separating brine from the oil, additionally heating the oil by a second heat interchange with residuum, expanding the oil and removing vapor and separating additional brine and residuum therefrom; and for an apparatus for treating and refining crude petroleum which comprises a connected series of heaters, a settling tank between successive heaters, a vapor tower connected to the last of said heaters, a connected series of oil stills, and a salt and water separator connected between the said vapor tower and said oil stills.

No. 1,592,328, granted July 13 to John C. Black, Destrehan, La., and Wirt D. Rial and Raymond T. Howes, Wilmington, Cal., for a process of purifying acid treated synthetic or cracked petroleum products having the boiling points of gasoline which consists in treating the products with a relatively weak alkaline solution to partially neutralize the products; in removing the weak alkaline solution; in mixing with the products thus treated a relatively strong alkaline solution and subjecting the mixture to a temperature not exceeding 350 degrees F. while preventing substantial vaporization of the products, to cause the relatively strong alkaline solution to break down gums and gum forming bodies, in cooling the mixture, in separating the alkaline solution; in mixing the products with a heavier hydrocarbon, and in then distilling the mixture to remove the gum and gum forming bodies.

No. 1,592,474, granted July 13 to Imre Szarvasy, Budapest, Hungary, for a process for the thermal decomposition of gaseous hydrocarbons, comprising passing the gaseous hydrocarbons into a decomposing chamber maintained at a decomposing temperature and provided with pervious walls, and heating said chamber at least in part by means of combustible gases passing from said chamber through said walls and burning in immediate proximity thereto.

No. 1,582,489, granted July 13 to Eugene C. Herthel, Chicago, and Edward W. Isom, Locust Valley, N. Y., assignors to Sinclair Refining Co., Chicago for a method of cracking hydrocarbon oils which comprises circulating the oil from and to a bulk supply tank through a heater maintaining a large body of oil in the bulk supply tank, heating the oil to a cracking temperature in the heater, causing a stratification of the oil in the bulk supply tank by obstructing the free flow of oil downwardly in said body and thereby confining the turbulence due to the introduction of the oil from the heater

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into the bulk supply tank to the upper stratum, and withdrawing oil from the lower stratum for recirculation through the heater.

No. 1,592,560, granted July 13 to Carbon P. Dubbs, Wilmette, Ill., assignor to The Universal Oil Products Co., Chicago, for a process for treating hydrocarbon oil consisting in initially passing the charging oil in a restricted stream through that portion of a heating zone maintained at the lowest temperature, in then uniting with the charging oil reflux condensate formed in the process and in passing the commingled charging oil and reflux condensate in a restricted stream through that portion of the heating zone maintained at the highest temperature, in delivering the highly heated oil from said stream into an enlarged reaction zone from which no unvaporized oil is permitted to return to either of said streams, in passing vapors from said enlarged zone to a dephlegmator wherein portions thereof are condensed forming said reflux condensate, in passing uncondensed vapors from the deplegmator to a final condenser, in collecting the resulting distillate and in maintaining a super-atmospheric pressure on the oil undergoing conversion.

No. 1,592,603, granted July 13 to Frederick Klein, New York, for a process of distilling a hydrocarbon which comprises alternately and successively heating and cooling the hydrocarbon in one container, the heating being approximately to the boiling point of the distillate desired.

Richfield Refinery Core of Complete Oil Company Unit

(Continued from page 27)

separate and smaller inspection device is so arranged that the hydrometer of proper range for the condensate produced, is suspended in a pool of constantly changing distillate. The device is so installed that regardless of the action of the still, or the major stream of condensate which flows through the larger look box; the gravity indicating stream does not become violent or change in its volume, but assumes a constant level.

Thermometer wells are provided and glass long stem thermometers indicate the temperature of the stream of distillate. In this manner the gravity of the stream is always before the stillman and thus, no time is lost in taking numerous samples of the various condensates. It is said that an additional advantage is shown in that the breakage of hydrometers is reduced to a minimum. The instruments often serve for periods of many months, and are finally removed only for checking against the standard certified hydrometers on hand in the laboratory.

There are seven look boxes of this type in the receiving house, and it is noticed that each one is provided with two inch lines rising to the ceiling, these lines are provided for still gas removal to the gasoline recovery plant previously mentioned. Gage glasses

are also provided at the front of each look box for the purpose of indicating the speed with which the condensate is removed through the manifold to the rundown tanks.

The still operator, it is seen, has constant knowledge of the condition of all streams, and also, through the indications of his recording instruments is at all times familiar with the operation conditions of the entire installation, without leaving the receiving house.

Cross Cracking Units

The Richfield Oil Company recently completed the installation of two 2000 barrel capacity Cross cracking units. This installation is what is usually termed a standard double 2000 barrel unit, operating at the rate of 4000 barrels through put daily. These Cross units are equipped with Foster type heating elements and furnaces. The plants are operating along the usual lines in that the recharging stock is recycled to the point where it is no longer profitable to expose it to the same conditions of temperature and pressure. The plants are not equipped with towers for the separation of gasoline in the one operation, but produces only pressure distillate. In this equipment everything produced at the skimming plant, below gasoline, and above fuel oil, is employed as charging stock. Thus, such distillates as gas oil, kerosene, and stove oil are subjected to cracking. Such operation practically reduces the products manufactured at the plant to two—gasoline and fuel oil. Some kerosene and special distillates are produced, as previously mentioned, to satisfy a certain demand for such material, but by far the bulk of the products from the crude charged is received as gasoline and fuel oil residuum.

More Portables Sold

A number of oil companies have purchased portable absorption plants to take care of new gas production during the last month. The Anglo-Mexican Petroleum Company, Ltd., is installing a plant at Tampico, Mexico; the Atlantic Oil Producing Company will have a plant at Slick, Okla.; a plant will be put in operation at Kelleyville, Okla., by the Major Gasoline Company; Amerada Petroleum Corporation and the Roxana Petroleum Corporation are installing additional plants, already having several in operation, and the California-Texas Gasoline Company will soon have a plant in operation in the Panhandle, Texas, a very active field at the present time. In California, Bolsa Chica, in the new field in Ventura, will shortly have a plant operating. All of these plants are of the "Southwestern" type, manufactured by the Southwestern Engineering Corporation of Los Angeles, Cal.

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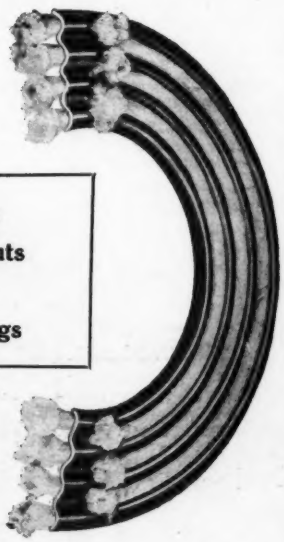

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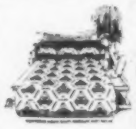

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GARLOCK 353 Oilblack Rubber Sheet Packing is compounded to resist the deteriorating action of oils and will give good service against heavy or light oil, hot or cold water, steam, ammonia, or alkali solutions.

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